JOURNAL
OF THE
AMERICAN WATER WORKS ASSOCIATION

VOL. 36, NO. 2 FEBRUARY 1944

In this Issue

Published Monthly
at Prince and Lemon Streets, Lancaster, Pa.
by the
AMERICAN WATER WORKS ASSOCIATION
Incorporated
500 FIFTH AVENUE, NEW YORK 18, N. Y.

PUBLISHED MONTHLY AT PRINCE AND LEMON STS., LANCASTER, PA.

Entered as second class matter January 23, 1945, at the Post Office at Lancaster, Pa., under the Act of August 24, 1912. Accepted for mailing at a special rate of postage provided for in section 1103, Act of October 3, 1917; authorized August 6, 1918.

Made in United States of America

JOURNAL
OF THE
AMERICAN WATER WORKS ASSOCIATION

Vol. 36 FEBRUARY 1944 No. 2

Contents

***All correspondence relating to the publication of papers* should be addressed to**

Harry E. Jordan, Secretary
500 Fifth Avenue, New York 18, N. Y.

$7.00 of Members dues are applied as subscription to the Journal
Additional single copies to members—50 cents
Single copies to non-members—75 cents

JOURNAL

OF THE

AMERICAN WATER WORKS ASSOCIATION

Vol. 36 February 1944 No. 2

Engineering and Water Works Practice

By Paul Hansen

IN 1940 the author reviewed the trend of water works practice with special reference to water purification.* The year 1940 was just before a period of active preparation for war; therefore, it might be appropriate at this time to review, insofar as this can be done on the basis of the observations of one engineer, the effect of the war on water works practice.

The Pressure Periods

The country has passed through two pressure periods in the matter of designing and building new water works and improvements to existing water works. The first of these pressure periods began in 1933, in the trough of the depression, and came as a result of the effort of the federal government to stimulate employment through the construction of needed public works. In the forefront of such needed public works were the water supplies of the country. Inasmuch as the employment of labor was the prime objective, engineers employed to design water works and water works improvements were placed under great pressure to turn out the construction plans and specifications in very short time. This limited the time required for study to produce well-considered plans and specifications and, therefore tended to reduce the quality of such plans and specifications.

Engineers were obliged to reach for "shelf hardware" so that the drafting work might proceed rapidly. This practice was not too serious if not kept up for too long and if the engineering office preparing the plans and specifications had its "shelves" well stocked with good designs for other works and with a good background of experience and well-developed judgment. When this practice is kept up year after year, however, it is certain to result in deterioration in the quality of design.

The second pressure period began with preparation for the war in the summer of 1941. The speed required of the engineer in planning works for

A paper presented on October 20, 1943, at the Milwaukee Meeting of the Wisconsin Section by Paul Hansen, Cons. Engr., Chicago.

* Jour. A.W.W.A., **32**: 1118 (1940).

the war effort was far greater than under the preceding PWA period; in fact, it made the engineer feel that hitherto he had not known what speed really is. In a number of the Army camps it was necessary to develop complete water supplies of a relatively complicated and extensive character within five months, from nothing at all to full operation. Fortunately, in those early days of war construction, engineers were not seriously hampered by the inability to obtain materials. This aggravation set in after the United States became involved in the war and it grew in intensity through the year 1942. In all, there have been something like ten years of pressure during which engineers have been forced to get out plans and specifications under conditions which are not conducive to best results. However, to the great credit of engineers engaged in water works practice, their work has been accomplished in a phenomenally short time and, generally speaking, the plants that have been built have been good ones and are giving good results.

Little Technical Advancement

During the first pressure period, design was based on the best thought then available and, in spite of the haste, some technical progress was made. During the latter pressure period, beginning in 1941, however, there was little to show in technical improvement. Engineers had been thinking principally of speed and of obtaining necessary materials when desirable materials were not available. Something was gained in technical knowledge when water works officials made rather thorough reviews of their water works facilities for the purpose of rendering them more secure against sabotage and bombing. Such reviews brought out many weak points, such as lack of cut-off valves, insufficient standby equipment, poor accessibility of valves and hydrants, necessity for regular inspection to insure operability, etc. None of this, however, actually improved knowledge in connection with water works design. It simply called attention to neglect in utilizing knowledge already available.

While considerable ingenuity has been exhibited in avoiding the use of critical materials, this has not resulted in any appreciable improvement of design for peacetime needs. On the contrary, much of the effort to avoid use of critical materials resulted in inadequate and temporary devices with the expectation that these will be replaced or improved at a later period. The degree of criticalness of materials has varied from time to time, requiring quick changes in design, and this has called for more ingenuity.

In the early part of the war, cast iron and reinforcing steel were regarded as highly critical. To obviate the use of cast iron for water pipes, cement-asbestos pipe was extensively used. Later cement-asbestos pipe became critical and cast-iron pipe more plentiful, with the result that some hurried and awkward changes had to be made in contracts for construction work.

To avoid the use of reinforcing steel, it was necessary to revert to construction practices of 40 or 50 yr. ago, such as the extensive use of brick masonry and unreinforced concrete. Heavy gravity sections were used for reservoir walls and if a reservoir required a cover, as in the case of filtered water reservoirs, unreinforced groined arches were used. While this form of construction provides a good structure, it is generally about 10 per cent more

expensive than reinforced concrete and requires first-class foundation conditions so that differential settlement may not take place. After some of these structures had been designed and built, reinforcing steel again became available and is now generally being used for necessary concrete structures.

Stimulus to Research

Much has been said about the great number of new materials and devices which would become available as a result of research along various lines in connection with the war effort. For example, it has been predicted that pipes made of plastic material would be generally substituted for metal pipe. Perhaps there is a place for pipes of plastic material, but such possibilities were being exploited before the war and would undoubtedly be accepted after a reasonable length of successful experience. It would be a mistake, however, to advocate and use extensively plastic materials until they are thoroughly tested. Adaptations useful in water works practice, however, may be found in the intensive research in other fields, such as aviation, communications and radar.

Patented Devices

Another development that has been obvious during the war pressure period is the promotion of patented devices in connection with water treatment, more particularly at ordnance works. This is encouraged by the necessity of making quick decisions and without the necessity of open competition. Companies furnishing water works equipment of special design were in a position to sell some equipment that had an inadequate background of experience and economy. Plans were in readiness so that construction could begin at once. The plans, of course, were stock plans of equipment, quickly adaptable to size and capacity for the particular job. Generally speaking, such equipment is over rated so that it may be sold in competition with other designs of the same nominal capacity. Actually, without alternate plans prepared by disinterested engineers on the basis of conservative ratings as to capacities, there was no real opportunity for making reliable cost comparisons.

Although apparently cheap, some of these proprietary installations were, in fact, somewhat extravagant as to money and critical material. For example, some small filtration plants with control valves, varying from $2\frac{1}{2}$ in. in diameter to 6 in. or at most 8 in., were provided with impressive filter operating tables controlling hydraulically-operated valves, whereas hand-operated valves would have been satisfactory and cheaper.

It is quite probable that some of these proprietary devices which have been pushed during the war have real merit and may be used in common practice. The rush with which the installations have had to be made, however, rendered it impossible to ascertain with reliability whether or not these schemes are meritorious in any particular situation. Furthermore, the secrecy and inaccessibility which necessarily surround new water works—more particularly those at ordnance plants—combined with the relatively inexperienced operating personnel at such plants, makes it difficult or impossible for engineers to get at the real facts.

Much the same promotional effort has been made in connection with certain collectors for ground-water supplies. The promoters recommend and

guarantee to gather a given quantity of water in a patented type of ground-water collector without having adequate knowledge as to the ground-water conditions. Furthermore, it is often impossible to obtain adequate knowledge of ground-water conditions in the limited time available. The result has been that some of these installations have not met guarantees, and thus vital ordnance works were short of water supply and had to make hurried efforts to get more adequate supplies in some other way.

While all these experiences may have been justifiable and even necessary under stress of circumstances imposed by the war, it cannot be said that such practices have contributed anything to the sound advancement of ground-water supply development.

Major Works at a Standstill

The coming of the war has prevented progress, or at least greatly slowed progress, on some of the major works throughout the country. This applies particularly to the additional water supply for New York City from the Delaware River drainage area, desirable improvements that might have been under way for the water supply of Washington, D.C., completion of the South District Filtration Plant for the city of Chicago and many others in smaller places. Fortunately, as a result of the preceding pressure period under PWA, some important large works were carried to completion before the war. This is true of the new water supplies for Toledo, Ohio, and Harrisburg, Pa.; important works for the water district of southern California; and a number of smaller installations.

Incident to this stoppage of work, a large number of water works improvements and additions are accumulating. These, more or less urgently needed, cannot be started at this time because they are not closely related to the war effort. This work can be utilized to assist in smoothing out the economic and social dislocations following the war. In this connection, however, it is important to recognize that time should be allowed the engineers for the proper preliminary studies, and the preparation of construction drawings and specifications. Such advance study and detailed planning is now being widely advocated, but as yet is not being fully put into practice. New York City has perhaps been foremost in anticipating the necessity for properly planning postwar work by making an appropriation of $30,000,000 for planning work only and, furthermore, a reasonable time is being allowed the engineers for doing their work.

Meterization

Because of critical materials, meterization programs have been brought to a standstill; this is particularly true in the city of Chicago. Meterization is the most effective way, if not the sole effective way, of conserving use of water. Conservation of water is essential in the war period to make available adequate supplies for war industries located in or near practically all of the larger cities. Water conservation also cuts down the use of critical materials in connection with water works operation and maintenance, such as fuel, chemicals, repair parts and lubricants. Some conservation can be effected by prohibiting sprinkling, stopping the use of fire hydrants for bathing in the poorer districts, more

frequent inspection of plumbing fixtures and appeals to the public through the newspapers and otherwise.

Statistics

All things in connection with water works are not standing still or retrograding, and some valuable studies and statistical inquiries have been made. For example, the U.S. Public Health Service in 1942 developed, with the aid of the various state departments of health, a comprehensive census of municipal water works installations together with the principal information concerning each. This has been published in a series of public health reports which are available to engineers.

Quality Standards

The U.S. Public Health Service has made another contribution by issuing under the date of September 25, 1942, a revised set of standards of quality of water for use on interstate carriers. Recognizing that the former Treasury standards were used and that the present standards will be used as a guide in municipal water supply practice, the present standards are accompanied by a manual of recommended water sanitation practice which will be most helpful in standardizing and co-ordinating water sanitation practice throughout the country. The new standards of water quality are somewhat more rigid than the 1925 standards, the latest of the Treasury standards, and are more specific and more complete in the amount of various metals and other chemicals permitted in water supplies and also cover the limits of permissable pollution of raw water prior to purification.

Progress has been made in recent years in connection with better understanding of chlorination and de-chlorination, with particular reference to taste and odor control and the continuous maintenance of good water quality in the distribution system. There have been some lively flare-ups of discussion relative to chlorination, as when the Sanitary Corps of the Army stipulated that there should be a residual chlorine of 0.4 ppm. when the water is delivered to consumers. Some authorities were prompt to point out that to maintain this residual would require excessive chlorination at the main treatment works in a large system and that it would be generally impracticable and unnecessary to retain such a residual. It was argued that such a residual or many times such a residual would not be effective in sterilizing the water in the mains should it become polluted by cross connections or accidents on the distribution system. It was also pointed out that if a water is once effectively sterilized before it is admitted to a properly designed and controlled distribution system, a lower residual at distant points in the system is of no significance. It is generally agreed by all concerned now that the 0.4 ppm. residual requirement is to be used intelligently and with some latitude and that there is no intention of insisting on a residual everywhere in the system of 0.4 ppm. Progress is also being made in more reliable methods of determining and recording chlorine residuals.

In 1940 fluorine in water supplies had become well recognized as a cause of mottled enamel of the teeth, and it was appreciated that fluorine in excess of one part per million was dangerous and objectionable. Further statistical studies made by the U.S.P.H.S. have indicated that quantities of fluorine of less than 1 ppm. are beneficial to the

teeth in that they prevent dental caries or tooth decay. Thus some fluorine is desirable, whereas too much is seriously objectionable, even though mottled enamel is accompanied by less dental caries. The value of small quantities of fluorine has again raised the question of medication of the public through the public water supply by introducing suitable amounts of the desirable chemical. In the early twenties when it became known that the absence of iodine in water caused or was predisposing to goiter, one city, namely Rochester, N.Y., did introduce iodine into the public water supply. After much discussion the general concensus of opinion among water works people now is that, while the public water supply should be treated in a manner that will render it reasonably soft, pure, palatable and sterile, water departments should not be called upon to administer medical doses of any chemical, and that such administration can be best accomplished through diet and the advice and prescriptions of physicians.

Floods and Spillway Design

The Water Works Committee of the Sanitary Division of the American Society of Civil Engineers reported in 1942 on the effect of exceptional floods during the previous two years on the design of dams used in connection with water supply and other purposes. They reported that, generally speaking, spillways are inadequate and should, wherever practicable, be made larger. The size of spillway necessary will, of course, vary with the size and characteristics of the drainage area, and also with local rainfall tendencies. But it seems to have been generally not fully appreciated that floods greater than those that have ever been recorded can occur in the future. On the other hand, the committee points out that spillways cannot be built of unlimited capacity sometimes because of physical restrictions, sometimes because of excessive cost. In such cases the cost of destructive effects due to inadequate spillways must be balanced against the cost of constructing adequate spillways. The committee submitted data which are of great value to water works engineers having responsibility for the design of impounding reservoirs, hydraulic power developments and flood control works.

Pipe Design and Pipe Protection

Some progress has been made in recent years in an understanding of pipe design and pipe protection. The slightest imperfection in a bituminous coating, such as a pin hole, will permit tuberculation to take place and where the metal of the pipe is imperfect, as it generally is, disintegration of the pipe metal may take place, ultimately resulting in breakage and leakage. Coal-tar enamel coatings for large steel pipe have been greatly improved and the American Water Works Association has done much through appropriate committees to develop good standard specifications. The present general trend seems to incline toward cement lining for cast-iron pipes. In new pipes this can be readily accomplished centrifugally. Larger pipes, of say 36-in. diameter and upwards, may be cement lined in place by means of ingenious machines that have been developed for the purpose. These machines apply the cement and trowel it to a smooth surface.

The trend toward cement linings has influenced thought among engineers in favor of reinforced concrete pipe for even quite high pressures, say

up to 200 psi. Reinforced concrete pipes are not affected appreciably by ordinary water, and thus carrying capacity is maintained and corrosive injury to the pipe is avoided.

Summary

The period of the past ten years has not been conducive to improvement of water works practice, though some progress has been made along some lines. War conditions definitely hinder water works progress, more particularly by limiting construction and limiting the materials available for construction. As the war progresses, there will be a period when those of us not in the armed forces may have time to think about, study, and plan postwar developments. Wherever water works improvements and enlargements are definitely needed and planning should begin now and be carried through to the stage of complete construction drawings and specifications, so that construction may start at any favorable time after the war.

IT is with extreme regret that we record the fact that Mr. Paul Hansen, author of the above paper, died suddenly on the afternoon of February 7, 1944.

Mr. Hansen, a brilliant member of the engineering profession, had been a valued member of the American Water Works Association since June, 1912, and always a loyal contributor to literature of the water works field.

California State Employees' Retirement Act and Its Effect Upon Municipal Water Utility Employees

By Carl K. Chapin

RETIREMENT systems in public service and private industry would appear to have their origin based upon recognition of the need of providing for the superannuated employee. Supplemental to this recognized need is the thought of the dependents of such superannuated employees, where death or disability occurs from either occupational or non-occupational cause. The interest of the employer, in the replacement of employees with declining efficiency due to age or incapacity, is frequently overrated.

The development of pension systems in the last decade seems to recognize more fully five principal factors equally important in gaging the success or failure of a particular system. They may be enumerated, without an attempt to place them in order of importance, as follows:

1. Social relations between employees and employer
2. Legal provisions and limitations
3. Financial support and soundness
4. Actuarial basis and tests
5. Administration and accounting

A recent report of the U.S. Department of Commerce, Bureau of Census, stated that in the beginning of 1942, a total of 1753 state and government systems had 1,868,196 employees, 80 per cent of them participating in retirement systems of over $1,785,486,000 in assets.

Many retirement systems, long in operation, have not been modified in such a manner as to make adequate provision for death and disability cases among employees. The origin of many of these older systems appears to prevent the addition of adequate provisions for such cases without serious changes in the financial structures, actuarial bases or legislative provisions for the maintenance of such systems.

Group life insurance as presently recognized by actuaries, with normal safeguards in its application, is barely 30 years old, having been introduced in 1912. Group life insurance has attained such huge proportions, however, as to be a large factor in total insurance carried by industrial employees.

Insurance men recognize the rapidly developing interest in hospitalization protection including its related possibilities of insurance to pay medical fees. In some quarters there is a tendency to attach unfavorable significance to this form of protection, believing it to be an undesirable aspect of socialized medicine.

A paper presented on October 28, 1943, at the California Section Meeting, Los Angeles, Calif., by Carl K. Chapin, Secretary-Administrator, Retirement Plan, Dept. of Water & Power, Los Angeles, Calif.

Legislative Act

The State Employees' Retirement System was established by legislative inactment in 1931 and became effective on January 1, 1932. This was: "An act to provide for the creation, establishment and adjustment with other such systems of a retirement system for employees of the State of California and of such cities, school districts and counties as may elect to include their employees pursuant to contract with the Board of Administration of such system, and making an appropriation therefor."

The act continues: "Section 1. The purpose of this act is to effect economy and efficiency in the public service by providing a means whereby employees who become superannuated or otherwise incapacitated may, without hardship or prejudice, be replaced by more capable employees, and to that end providing a retirement system consisting of retirement compensation and death benefits."

The absence of a specific reference to disability while in active service is explained in this manner. Disability may be defined as in "Section 23d—'disability' and 'incapacity for performance of duty' referred to herein as a basis of retirement, shall mean disability of permanent duration or disability of extended and uncertain duration, as determined by the board on the basis of competent medical opinion."

It will be apparent that temporary lack of capacity to perform duties is not included in the protection afforded employees in this state act and further, it is evident that disability as covered, is associated with retirement provisions, requirements and economics and not a separately established benefit, the scope of which may be actuarially studied and fully provided for upon an independent basis.

Contract Provisions

Muncipal employees within the state of California under conditions set forth in this act may elect to participate in the State Employees' Retirement System if the legislative body of the particular municipality enters into a contract with the Board of Administration of the system, subject to the provisions of this act.

The act speaks for itself with respect to the initial approval and possible termination of such a contract in Section 38c as follows:

"Section 38c. After receiving from the Board of Administration, a quotation of the approximate contribution provided for in Section 58b, any municipal corporation in the State may participate in the State Employees' Retirement System, making its employees members of said system, by contract entered into between the legislative body of said municipal corporation and the Board of Administration of the said retirement system, subject to the provisions of this act. Said contract may include any provisions consistent with this act, necessary in the administration of the retirement system as it affects said employees and municipal corporation. The approval and termination of said contract shall be subject to the following provisions, in addition to the other provisions of this act:

(1) Said legislative body shall adopt a resolution giving notice of intention to approve said contract, which resolution shall contain a summary of the major provisions of the proposed retirement system. Such contract shall not be approved unless and until an election has been held to permit the employees proposed to be included in the retirement system to express by secret ballot their approval or disapproval of said retire-

ment proposal. The ballot at such election shall include the summary of the retirement system as set forth in the foregoing resolution. The election shall be conducted in such a manner as to permit the firemen, the policemen and the other city employees proposed to be included in the system separately to express their approval or disapproval thereof. Said election shall be conducted in such manner as shall be prescribed by the legislative body of the city. Approval of the contract shall be by ordinance adopted by the affirmative vote of two-thirds of the members of said legislative body, not less than 20 days after the adoption of said resolution. The legislative body shall not include in the retirement system any of the three groups above mentioned, a majority of whose members voted to disapprove the proposed system.

(2) Said legislative body may terminate said contract by the adoption of a resolution giving notice of intention to terminate and by the adoption, not less than one year after the adoption of said resolution and by the affirmative vote of two-thirds of the members of said legislative body, of an ordinance terminating said contract.

(3) The Board of Administration may and it shall be its duty to terminate said contract, by resolution adopted by a majority vote of its members, effective 60 days after notice of the adoption of said resolution has been mailed by registered mail to the legislative body of said city; provided, said city shall fail for one year to pay to the system any installment of contributions required of it by this act.

(4) Forthwith upon the termination of said contract, all memberships in the retirement system existing because of said contract, shall be terminated, and for the purposes of Section 75, the employees whose memberships are terminated, shall be considered as permanently out of State service, and their accumulated contributions shall be refunded accordingly. Notwithstanding anything in this act to the contrary, no event occurring on or after the effective date of said termination, shall be considered in determining the right of any such employee to a death benefit or to retire for service or disability.

The right to a retirement allowance, of a person who has retired prior to the effective date of the termination of said contract, or who has qualified and applied for retirement by written document received at the board's office in Sacramento, California, prior to said effective date, even though the board shall not approve said application until a later date, and the right of any person to a benefit on account of a death which occurred prior to said effective date, shall not be affected by said termination of said contract, except as herein provided in the event the contracting city shall fail to make contributions required of it because of the participation of its employees in the system.

(5) Upon the termination of said contract, the Board of Administration shall refund to said contracting city such portion of the accumulated contributions then held by the retirement system and credited to, or as having been made by it, as are in excess of an amount actuarially equivalent, as determined by the actuary and approved by the board, to all benefits the system is obligated to pay after the effective date of said termination, to or on account of persons who are or have been employed by said city, and on account of service rendered by said persons to said city. If the said accumulated contributions credited to, or as being made by said city at the date of said termination, shall not be at least equal to said actuarial equivalent, said city shall contribute to the retirement system under terms fixed by the Board of Administration, an amount equal to the difference between said accumulated contributions and said actuarial equivalent. If said city shall fail to make such contribution, the portion of benefits described in the first sentence of this paragraph, payable after the board declares said city in default of said contribution, from the contributions previously made by said city, shall be reduced in the proportion the said accumulated contributions credited to, or as having been made by said city, bears to said actuarial equivalent of said benefits as of the date said board declared the default. The right of an employee of a contracting city, or his beneficiary, to a benefit under the system, whether before or after retirement or death, shall be subject to the adjustment provided in the sentence next preceding. The Board of Administration may postpone the payment of any amount due to said city, under this paragraph, if to make said payment would require the sale of securities, which, in the opinion of the board, would affect adversely the interests of the retirement system. If the board delays said payment longer than the period reason-

ably necessary for the determination of the amount due and for the necessary action by the board, interest shall be allowed on the amount remaining due and unpaid from time to time, at the rate then in use under the system, and shall be paid to the contracting city at the same time and in the manner as the original amount due.

(6) Said municipal corporation shall include under said contract all of its firemen and policemen and/or all of its other employees, except as exclusions may be agreed to between it and the Board of Administration, said exclusions to be based on groups of employees such as by departments, by duties or by age, and not on individual employees. The Board of Administration, however, shall have the right to disapprove the exclusion of any group, if in its opinion said exclusion affects adversely the interests of said retirement system. Membership in the retirement system shall be compulsory for all employees included under said contract.

What could employees of water utilities reasonably expect as benefits resulting from participation in such a system and what would be the contribution costs of employees and "Contracting City"?

Service Retirement

"If retired at age 65, allowance of approximately $\frac{1}{70}$ of average salary earnable during 5 years immediately preceding retirement, for each year of future service, that is, service after January 1, 1932, as a member of the System. . . . Prior Service credit at the cost of the municipality may be granted in whole or in part depending upon the contract with the municipality.

"If retirement is below 65, allowance per year of both prior and future service is decreased and if above 65, allowance per year of only future service, is increased.

"Allowance to cease at death of retired member with no death benefit, unless he elects at retirement to receive a smaller allowance and to leave a benefit for his beneficiary."

Disability Retirement regardless of age, but only after having 10 yr. of service, is as follows:

". . . 90 per cent of $\frac{1}{70}$ of average salary during 5 yr. immediately preceding retirement, for each year of service, with a guarantee of 25 per cent, of said average salary with certain exceptions, provided that the total disability allowance shall not exceed the service retirement allowance the member would receive if employed continuously until retired at the nearest age upon which he would qualify for service retirement.

"Allowance to cease at death with no death benefit, unless member elects otherwise as in preceding. . . ."

If such a permanent disability were incurred in performance of duty there would also be benefits payable under the State Compensation Act.

Death benefits before retirement are ". . . one-twelfth of salary earnable during year immediately preceding death, for each year of service as a member of System, not to exceed six, plus contributions of member, with interest, in lump sum."

Upon separation from service by other cause than death or retirement, provision is made for the withdrawal of member contributions as follows:

"Refund of contributions of member, with interest, immediately upon resignation or discharge, and at request of member upon lay-off. Withdrawn contributions may be redeposited upon re-employment, in not more than 12 monthly installments, thus restoring credit for service."

Voluntary Service Retirement for employees of contracting cities is contingent upon 20 yr. of continuous service credited under the act when requesting permission to retire at the age of 60 or older. Compulsory service re-

tirement applies to those who have attained the age of 70 yr.

Growth of Retirement Systems

The trends of adequate retirement systems in the last ten years seem to indicate that future systems, to be successful, must provide financial and actuarial soundness with leeway for necessary revisions as major changes occur which affect the current stability or future outlook from time to time. It would appear that the best foundation for favorable social relations is one in which the out-of-pocket cost of a well-balanced system of retirement, disability and death benefit is divided equally between the employee and the employer. We consider the out-of-pocket cost as the current contributions to such a system by employer and employee at the time labor service is rendered. If we add to this foundation of equal sharing of out-of-pocket cost, and its complement of adequate trusteeship of system funds, the remaining social relations bond of joint responsibility and voice in control, there can be little else necessary to add, unless it be the liberal use of independent expert advice or consultation services in the fields of medicine, investment, accounting and actuarial practice.

Protection of Funds

Perhaps the most important phase of all such retirement systems is the realization that such contributions are held through some trusteeship, and while so held must not only be protected against all normal investment hazards but, in addition, the interest accretions to such trust funds must currently play a contributing part equal to, or even greater than, the out-of-pocket cost of initial contributions by either the employee or the employer. Unless the major contribution from interest earnings is made possible through the proper handling of such a trust, we may reasonably expect to have a system with either one of two extremely unfavorable characteristics—either a prohibitive cost of direct contributions to pay benefits as they mature, or a reduction in these benefits to the point where minimum needs are not satisfied by the benefits as actually paid. In the handling of such a trust we do not dwell much upon the possibility that funds may be lost to any extent. Individuals may speculate with savings, but a pension trusteeship must choose a course so conservative in its principles and policies that losses are limited to an irreducible minimum, well within some nominal provision for such losses, that of itself is no burden to the financial accomplishment of the long-term objectives of a well-designed system. Safety therefore is not a relative term when referring to sound financing of retirement systems. Safety should be absolute.

Interest Earned

An examination of interest rates earned by various retirement systems and the interest rates on new investments and refunding operations will indicate a steadily decreased value of interest on borrowed money with no indication as yet that the low point has been reached. Interest earnings on the highest grade long-term investments are lower today than at any time in 50 yr.

California seems to have a wide variety of laws authorizing systems of pension, disability and death benefits for employees, ranging from compulsory protection of the industrial worker for disability or death arising from occupational causes, to the state control of voluntary systems among county

employees and employees of municipalities. In addition, there are a number of chartered cities having independent systems under special charter provisions applicable to the individual municipality.

Pension Practices

From time to time legal actions arising in some of these systems have resulted in court decisions which have passed judgment upon or defined the responsibilities of these systems and their participating employee members.

Federal social security legislation and recent pension practices in other public and private institutions go far toward setting the patterns for generally accepted ideas which have largely reconciled the economics of public interest, employee and employer. Standardization of pension practice in industry and public service while not yet a reality is fast approaching uniform concepts in benefits and practices. Earned pensions, jointly contributory, by right, must not be confused with pensions based upon need or doles at the expense of taxpayers.

We are concerned here with earned retirement allowances and other benefits which have been created by the monthly contributions of an employee and his employer on an approximately equal basis. When benefits within reason have been selected and the amount of contributions, which will establish a full reserve basis for them, have been determined, nothing but ignorance or mismanagement should ever be able to jeopardize the future accomplishment of the ideals set forth.

The history of the failures and repudiation of obligations of retirement systems offers ample proof of the wisdom of wise forecasting of obligations and financing and the necessity of carefully recording and reporting the transactions of retirement systems.

Effect of the Retirement Act

Long-range planning is not new to municipal water utilities. It is an old story to plan wisely for the future of these utilities. Community life, health and business welfare depend upon this careful technical background of planning. Is it strange that some such approach should be justified, yes, *required*, when it comes to making proper provisions for the life, health and welfare of the employees of such enterprises? The investment in inanimate structures is less important in upkeep and replacement than the human investment so necessary to its construction and operation.

The effect of the California State Employees' Retirement Act upon Municipal Water Utility Employees is two-fold. First, it affords a striking example of a retirement system founded upon a reserve basis with every chance, under wise administration, of fulfilling for all time the purposes intended. Second, it affords a yardstick for comparison with other systems and policies intended to serve similar purposes and may therefore be patterned after, in a large measure, by systems which do not elect to join the state system.

The following outline of this state system is that of an outsider, who, in seeking to point out certain high lights of great importance, realizes that the opportunity exists to fail utterly to place proper emphasis upon other features of so large a system.

Minimum Guarantee

The state employees minimum guarantee of $40 per month or $480 per year for those with prior service and

retiring at the age of 70, does not apply to the members who are employees of a contracting city unless provided for in the contract between the Board of Administration and the contracting city.

What do employees pay per month for their share of the cost of a retirement system such as we have been discussing where normal retirement is at the age of 65? Rates of contribution for males usually have varied from approximately 4 per cent of salary at 21 to 7 per cent at the age of 60 with rates for females somewhat higher. These rates are based upon age at entry into the system and with continuous service remain the same throughout employment. Re-entry after a break in employment usually brings a new rate based upon the age at re-entry. When interest rates for trust funds were 4 per cent the rates may have been lower. With interest rates dropping so that some forecasts expect as low as 2 per cent, it is apparent that contributions may be greatly increased at some future time.

All are agreed that some measure of security during and after our years of employment is fast becoming common in industry and public service. If the measure of benefits can be determined and agreed upon, the cost becomes a fixed element based on the value of money held in the required reserve accumulations and there can be no compromise between the willingness to drift, in spite of better judgment, toward ultimate failure, and the determination to achieve success despite all difficulties.

Victory Garden Rates and Problems

By C. P. Harnish

IN order to approach the subject of "victory garden rates" it was thought wise to canvass a representative group of water works operators throughout the state to see what they have done along these lines during the season of 1943, what their experiences have been, what their opinions are of the results obtained and what they propose to do for next year. The response to the questionnaire which was sent out has been very gratifying and I should like to take this opportunity to thank each and everyone who has so cheerfully sent in such complete reports on this very vital and somewhat controversial subject. Many of the replies warranted personal answers which time did not permit making, but thankful acknowledgment is here made to all of you who have been so helpful.

Over 50 replies were received from municipalities or water companies representing a total of 80 communities. This gives us reports on a very large percentage of the urban and suburban population of the state. By far the greatest portion, representing 60 communities ranging in size from the very largest to the smallest, have had victory garden rate plans of one sort or another during the 1943 season. The minority is represented by 20 communities reporting that they had no special rate for victory gardens. Of these 20 all, without exception, reported that their existing water rates were so low that no additional consideration to victory garden growers was warranted, and from the examples of their regular rates which were cited, this statement can readily be believed.

The victory garden rate plans which have been adopted by the majority of the municipalities and companies, representing probably 75 per cent of the state's population served by public water supplies, fall into three general classes:

(1) For metered service, those with a plan which is available to all consumers who qualify and which specifies a certain volume of water per unit area of garden and provides a special reduced water rate for this volume. There are a number of variations of this idea or plan, but in general they all conform to this underlying principle.

(2) The communities served by flat rates, with various methods of providing for victory gardens over and above what ordinarily they would be entitled to to irrigate at the normal flat rate charge.

(3) All others who have any sort of plan at all for victory gardens.

A paper presented October 29, 1943, at the California Section Meeting, Los Angeles, Calif., by C. P. Harnish, Exec. Vice-Pres., Southern California Water Co., Los Angeles, Calif.

These might be termed the "non-conformists."

Seventeen cities and companies serving 44 communities have adopted the first plan, which might be termed the "standard" or "California" plan. Included in this group are the largest cities in the state, such as Los Angeles, San Francisco and the East Bay cities, as well as a good cross-section of smaller ones. Under this plan it was necessary, in all cases, for the consumer who desired to avail himself of the special victory garden rate or rebate to sign an application therefor, stating among other things, the area of his garden and agreeing to keep it up during the season. In a number of cases it was stipulated that the gardens must be for home use and the produce was not to be sold commercially, although a number of cities did not concern themselves about this. In all cases a certain minimum size garden was made mandatory for those who would avail themselves of the special rate, this minimum-sized usually being 300 or 400 sq.ft., although varying over a range of from 100 to 2500 sq.ft. A few placed a maximum limit on the size of garden which would qualify, such as 5000 sq.ft., in one case, and 10,000 sq.ft. in several others.

General Plan

Under this general plan a definite amount of water was allowed for the garden area, usually running from 2 to 3 cu.ft. per square foot of garden for the season, and in some cases the allotment was figured in inches per month over the area planted. A very low rate was then charged for this victory garden water allotment, this rate varying from as low as 3.5¢ per 100 cu.ft., in one case, to 10.9¢ in another; the average rate among the various cities running from 4¢ to 5¢ per 100 cu.ft. Several typical examples of this method are as follows:

"Consumers irrigating gardens served through a meter installed for domestic service shall pay regular monthly domestic rates for all water served through such meter in excess of that included in the minimum rate as follows:

"For gardens 1000 sq.ft. in area, the rate for the first 500 cu.ft. shall be 6¢ per 100 cu.ft. For each additional 200 sq.ft. of garden the consumer shall be allowed to purchase an additional 100 cu.ft. of water at 6¢ per 100 cu.ft."

Another example is the following:

"For victory gardens for which water is taken through the regular house meter, enough water will be allowed each month to cover the garden area 4 in. deep. This amount of water will be considered as the last water used through the meter and will be sold to the consumer at 50 per cent of regular rates."

Certain other cities utilizing this plan made an outright reduction of the rates over the minimum for anyone who certified that he planted and was maintaining a victory garden of an area above the prescribed minimum.

In several cases victory gardeners were entitled to a certain amount of water (in one case 400 cu.ft.) above the minimum free of charge.

Second variation of this plan, and the one utilized by the state's three largest cities and several of the larger private water companies, was the giving of a seasonal rebate or credit to the qualified victory garden grower based on the difference between the regular, domestic water rate and the bare cost of production applied to the garden allotment. The reduction in rate varied from 7.5¢ to 10¢ per 100

cu.ft., and considering the amount allowed per unit area of garden made for a seasonal rebate varying from 10¢ to 37.5¢ per 100 sq.ft. of garden. The seasonal rebates were made either at the beginning of the season, after the garden area had been checked by the water department or company, or at the end of the season. All required that the consumer pay his regular minimum bill, the rebates applying only to water used over the minimum allotment. A typical example of this sort of rebate is as follows:

Assume a garden is 22×43 ft. This will have an area of 946 sq.ft. and will be entitled to a 2-ft. depth of water for the season, or 2 ft. $\times$ 946 sq.ft. = 1892 cu.ft. The rate reduction from 22¢ to 7¢ per 100 cu.ft. is 15¢ per 100 cu.ft. The credit to be allowed for the season thus becomes: $\$.15 \times \frac{1900}{100} = \$2.85$ and this amount will be deducted from the water bill computed at the regular rates. For gardens with other dimensions, the credit will vary according to the total area.

Flat Rate Billings

The cities and companies adopting the second general type of plan for communities billed by flat rates obviously had a different sort of problem. Mostly the regular rates provided that a consumer was entitled to use water for a reasonable amount of ground surrounding his house, so no special consideration was needed for the average flat rate customer who wanted to convert a part of his back yard to a victory garden. Therefore, provision had to be made only for those who wanted to use an extra amount of ground for gardens such as the vacant lot next door.

One typical way of handling this problem was the granting of free water, on an area not exceeding 2000 sq.ft., to families now using city water, providing their present lots did not exceed 13,000 sq.ft. and that the water was taken from existing taps. This required a certain amount of checking to see that the 2000 sq.ft. allowance on vacant lots was not exceeded by consumers.

Combined Rates

There was a group of cities and companies with victory garden rate plans of one sort or another that just cannot be classified. There were 11 of these and each had its own individual plan that had no conformity with the others, except that some concession was made to the growers of victory gardens. A few of these, all on metered rates, made no reduced rate or rebate for growers of vegetables on their own premises, but would grant concessions to those who utilized adjoining vacant lots that could be served from the house meter. Several provided a combined irrigation and domestic rate applicable, however, only to fairly large plots. Several also provided a certain amount of water free above the minimum allotment for all who had gardens over a certain minimum size, without any attempt to differentiate between those who had just the minimum-sized garden and those whose gardens were much larger. It could be seen that most cities in this group were trying to do something for victory garden growers, with a minimum of fuss and work on the part of their field and billing departments, and in this respect it must be conceded that this general idea has merit, at least for the smaller organizations.

Results Obtained

As to the results obtained, upon analyzing those who adopted the more or less standard Plan No. 1, we find the average garden area in square feet ran from 600 to 3400 sq.ft., the general average being approximately 2000 sq. ft. The average rebate or credit per victory garden customer for the season ran from $1.83 to $6.50, the general average running around $3.50.

The percentage of domestic customers who availed themselves of this type of victory garden credit ran from 8 to 30 per cent, the general average running around 20 per cent. The total amount of rebates or credits for the season to victory garden growers was as high as $150,000 in one case, representing 6.3 per cent of the total revenue for the corresponding period. In practically all cases the increase in revenue over the corresponding period of 1942 equaled or exceeded the victory garden rebates. In other words, as far as gross revenue was concerned, all those who adopted this plan seemed to suffer no net reduction in gross revenue thereby. In most cases, however, it would appear that the increase in revenue was due more to the increase in consumers or from the increase in industrial revenues than to the stimulus to domestic sales because of the victory garden rate, although this is purely the deduction of the writer and, in all cases, not supported by sufficient data.

For those adopting Plan No. 2, statistics are not available on a comparable basis.

Under Group No. 3, the gardens, for the most part, seemed to run a little larger than in Group 1, one city going as high as an average of 8000 sq.ft. The average rebate per garden for the season ran from $1.91 to $6.50, and the percentage of customers taking advantage of this plan in the various cities ran from 7.4 per cent of the total domestic customers up to as high as 27 per cent. This group represented, for the most part, smaller cities, including none of the state's largest, and thus the total victory garden rebates were of more modest amounts. The percentage of the rebates to the total revenue ranged from 0.5 per cent up to as high as 8.5 per cent.

Reaction of Operators

How do the operators feel about their victory garden plans? Those adopting the standard Plan No. 1, with one exception, stated, substantially, "We had no serious difficulty in meeting our water demand because of the Victory Garden Plan." The one exception stated that the capacity of his distribution system was overtaxed.

Was there any difficulty experienced in handling the additional office work, including the billing? The majority said, "No," but three said, "Decidedly yes," and several qualified their answers. Apparently this phase of the operations is definitely something to reckon with.

As to difficulties experienced in field checking of gardens, the majority experienced none, although most of them felt it was a big nuisance.

The operators were all asked their opinion as to whether or not the victory garden water rate plan had been successful: (a) from the standpoint of the water department or company, and (b) from the standpoint of consumer good will. As to (a), all but two answered "Yes." One of these was not so sure, but the other one replied with an emphatic "No." The majority replied affirmatively to ques-

tion (b), to the effect that the plan was successful from the standpoint of consumer good will. Three, however, said "No" to this, and several were "not so sure."

All were asked the question, "As you now see it, are you going to recommend a similar plan for next season?" While the majority answered "Yes," a number had certain qualifications which are important to note. One stated as follows:

"A special victory garden rate has resulted in a great deal of additional work on the part of our staff, but under the existing circumstances it is believed that the plan as adopted served its purpose and resulted in developing good will among those interested in the production of vegetables by home gardens. Where gardens were grown in back yards formerly used for flower beds and lawns, very little, if any, increase in water use has resulted. However, where vacant lots have been used, the amount of water consumed thereon will, of course, be in addition to that which ordinarily would be required. *We all look forward to the time when it will not be necessary to establish such special rates, and I am sure that this is the general feeling among all Water Works Associations.*"

Another gave his frank opinion as follows:

"Generally the size of victory gardens in this city is quite small, so that the seasonal rebate is of minor proportions. Many, thinking the seasonal rebate was a monthly amount, were greatly dissatisfied upon learning otherwise. From our standpoint the benefit to the ordinary customer did not warrant the bother and inconvenience of applying the rebate. The greatest benefit to the war effort was the increased number of victory gardens due to advertising low water rates."

One operator unburdened himself as follows:

"Rates should be liberal, showing substantial savings to consumers, or no rates should be extended. Rates should be thoroughly explained. We have given rebates of 1¢ and 2¢ but without proper understanding of the victory garden rate it only causes hard feelings."

In this particular case, the rebates were given monthly.

Continuing Plans

Summing up the views of those large operators, together with quite a sprinkling of smaller ones who have utilized this plan of victory garden rebate, we find them fairly well satisfied with the results and of the opinion that they will carry on with similar plans next year.

The other group, representing a good cross-section of the smaller and medium-sized cities, with minor exceptions, feel that the victory garden plan that they have adopted has not resulted in any serious operating problems either in meeting the water demand or in the resulting additional office work.

Having such a wide range in type of plan, running from a very nominal reduction to giving free water, it is natural that the opinions as to the success of each particular plan, both from the standpoint of the company or department and from that of customer good will, varies widely. Some operators who are on the doubtful side express themselves as follows:

"It has been our experience, in administering this Victory Garden Ordinance, that where the applicant is thoroughly advised and understands

all of the conditions, the amount of water allowed and how it is to be paid, no complaints resulted. However, in most instances the applicant is not interested in a detailed explanation, nor does he make any attempt to understand the plan, with the ultimate result that he is disappointed when he has consumed the water allowance. Therefore, if it were possible to give the applicant a comprehensive explanation the arrangement would be, in general, satisfying."

Consumer Reaction

The theme that seems to run through a number of the replies is to the effect that there seem to be almost insurmountable difficulties in properly explaining the victory garden plan. That the consumer has difficulty in understanding some of these plans seems perfectly natural to the writer, who must confess he, too, could not grasp some of the pertinent points, at least at first glance, even when supplied with official copies. Consequently, the average customer is either apt to consider the whole thing a farce or a joke and not worth bothering about, or, on the other hand, he expects a whole lot more than he ultimately receives. Another man is very frank and makes the following statement:

"Handling victory garden accounts is just a big headache to the office. I had to employ an extra girl for four months to help out on the extra work involved. We have found that people take advantage of the rate long after they have tired of trying to farm. It is all well and good as long as the weather is cool and the insects don't interfere with the garden. I don't think that 75 per cent of the people should pay for the few who want to have gardens. Water men have enough troubles without taking on gardening as a side line." This comes from a man in charge of a system where 400 cu.ft. of water above the minimum is allowed absolutely free to the victory gardeners, providing they plant and maintain gardens of not less than 500 sq. ft. and agree to pay their water bills promptly.

Seasonal Rebate

Before drawing any conclusions, I should like to give you some of the experiences in our own company where we have just finished a season of victory gardening in 25 of our systems:

Our plan provided for a seasonal rebate of 20¢ per 100 sq.ft. of garden area, to be applied at the end of the season which extended from April through September. No consumer's monthly bill could be less than the monthly minimum for the size of service to his premises, and thus the credit allowance is applied only to the amount of water used over the minimum allotment. Each applicant for the victory garden rebate had to have a garden of at least 200 sq.ft. in area and agreed to maintain it throughout the season. If not, the company reserved the right to modify, pro rate or cancel the credit. Our rules on file with the Railroad Commission also provided that if we were unable to meet all requirements and the irrigation demand, too, then the company reserved the right to refuse the service of irrigation water and discontinue the victory garden credit. It was not necessary to resort to this provision. It was further stipulated that the consumer, to qualify for the victory garden credit, must sign the application therefor prior to May 15, 1943. As a matter of fact, we allowed an extra 15 days of grace, but despite this, there were quite a few

customers who came to sign up for the victory garden credit after June 1, and these necessarily, in fairness to all, had to be denied.

Varying Rebates

In closing the books on the victory garden matter, we find we had a total of 7533 customers who qualified for a victory garden rebate. This represented 13.7 per cent of the total domestic customers in the districts affected. The average garden area was 2200 sq. ft., and the average rebate per garden $3.34. The average rebate and the average size of garden varied considerably among the various districts, the rebate running from a low of $1.99 per garden to a high of $5.80. Since the rebates on the larger gardens did amount to considerable sums, it was only prudent that we check these rather closely. We paid particular attention to those with areas of 500 sq. ft. or more to be sure that, first, we had the correct measurement of the garden, and secondly, that the garden was kept up throughout the season. Where it was not, the credit was of course pro rated to allow for that portion of the garden abandoned. We feel now that it definitely was a mistake not to have limited the size of the gardens. As it was, too many growers of large gardens got "free rides."

In one of our districts, where there were a total of 513 victory gardens which qualified for the rebate, 86 were of 5000 sq. ft. in area or larger. These were actually billed for a total of $1,495.03 for the period in question, and our rebates have run $875 for this group of consumers, or 58 per cent of their total water bills. Looking at it another way, the rebates for 72 of these 86 consumers are so much that it leaves them only paying the minimum charge for water during the irrigating season.

In another district, out of a total of 758 victory gardens, 50 were larger than 5000 sq.ft. in area. These 50 contributed a total of $1,555 at the regular rates, with a total rebate of $800, or 52 per cent. After allowing for the rebates, 28 out of the 50 were left with but minimum bills for the season.

It can be seen why some reasonable limit should be imposed on the maximum size of garden which will receive a rebate, since on so many of the larger ones, for one reason or another, relatively little water is used. No water company can afford to say, in effect, to its consumers, "If you plant a garden of 5000 sq.ft. area, or more, we will charge you only the minimum for your size of meter during the irrigating season, for all water used in and about your house and on its grounds, as well as on your victory garden."

How do our district superintendents, the men who actually deal with the consumers, feel about our victory garden plan? Answering the question as to whether or not our victory garden rebate plan has been successful in promoting customer good will, four of them say "Yes," one of them qualifiedly; four say "No"; and four are on the doubtful side. As to a victory garden plan for next year, only three are definitely for it, with nine opposed.

Summary

The most important suggestion is to be sure that your plan is understandable and simply stated. The special victory garden rate or rebate should be set forth in unmistakable terms and the time and manner of making the rebate and the length of the season during which the special rate or rebate

would be in force should be definitely stated.

For those who grant a certain definite amount of water per unit area of garden (and this seems to be the best and fairest sort of plan that can be devised), I strongly recommend a fairly large minimum size of garden which a consumer must have to qualify, and that a maximum size also be imposed. Under any plan the amount of savings to a consumer for a garden of less than 500 sq.ft. in area is going to be so small that really it isn't worth the time and effort which must be given to handling the account. Besides, all the water a customer could properly use on a 500 sq.ft. garden for the season would not be over 1000 cu. ft., and certainly not over 1500 cu. ft. Thus, at the regular domestic rate, the bill for watering his garden for the season would only run a couple of dollars at the most, and certainly in these times there just does not seem to be justification for granting a special rebate to this class of user.

On the maximum side, our experience certainly shows that a great majority of the larger gardens don't use as much water per unit of area as do the smaller ones. There are a number of reasons for this. In the first place, the larger grower is apt to know better what he is about, and not be wasteful of water. Then, too, in many cases the larger gardens have considerable areas devoted to single crops such as corn, tomatoes or potatoes and the seasonal irrigation use on these crops is usually less than that on diversified crops, with replanting when one crop is harvested. For those so inclined, there is also the opportunity of deliberately taking advantage of the water company. While there is no feasible way of entirely preventing this, it can be kept within bounds by limiting the maximum amount of the rebate. Therefore, my recommendation is that the minimum size of garden for which a special water rate or credit is given should be no less than 500 sq.ft., and the maximum no more than 5000 sq.ft.

As to the time of making the rebates, where this is not done monthly, it seems to me it should be done during the latter part of the season. How else is it possible to check up and see if the gardens are being maintained? We found that this was very important, since, in so many cases, big areas of gardens, or what their sponsors hoped would be gardens, were abandoned, not cultivated and certainly not irrigated after the first month or so. Even in well-kept, bona fide gardens, various crops matured in several months and no replanting was done.

Looking now at the real issue, as to whether or not special rates for victory gardens are justified, the following points are worth considering:

Are Special Rates Justified?

(1) In the season just closed, no water utility was hurt very much, economically, by granting victory garden rebates. For one reason or another, revenues stood up well enough to stand the shock of the rebates, and practically everyone will close his books for the year with gross revenues equal to or better than 1942. At the worst, some additional water had to be provided and extra work resulted in handling the victory garden accounts, and this, while a great nuisance and the cause of considerable grousing on the part of the affected employees, will not be the deciding factor in determining the success or failure of the plan. However, it would seem that the records, as well

as certain "straws in the wind," point to definite danger signals ahead and indicate that, while certain offsetting factors on the credit side were present last year, they may not be there again.

(2) While it would appear that the victory garden credit plan is to some extent a beneficial adjunct to the regular water business, and to some degree helpful in stimulating business, yet it is still an experiment and should be so considered.

(3) While in some measure the victory garden credit plan approaches the various incentives which have long been adopted by the electric and gas utilities, the extent to which it does really stimulate business still cannot definitely be ascertained.

(4) Looking at 1944, without any increase in number of consumers possible, except in those few areas where emergency housing is permitted, it would seem that little increased business could be expected over that experienced in 1943. In other words, we may be at the end, temporarily, of our present growth cycle. Therefore, victory garden rebates from now on will have to stand on their own feet, economically speaking.

(5) It would seem that any who do continue their victory garden plan this year should expect, also, a much greater percentage of applicants who wish to avail themselves of the plan than was the case this year. Last year, it wasn't that so few people planted gardens, but that so few took the trouble to go to the water office and sign up for the special rate. The news about the rebates, or savings, to those who did sign up will spread and the size of the rebates probably will grow in the telling. As it is human nature not to want to be left out of any good thing like this, many more applicants should be waiting on the doorstep come next victory garden season. Therefore, all water works operators should look this situation fairly in the face. Take our own case, for example. Suppose we have such a plan this year, but instead of 13.7 per cent of our domestic customers availing themselves of it, 50 per cent do. I shudder to contemplate the implications of that assumption. Then, is it fundamentally fair to grant this form of rebate, or give this special concession to just a small portion of our customers, knowing full well that we just could not afford to give it to anything approaching the majority?

(6) In 1944, too, the emphasis may have to be placed on water conservation, and so we may have to look to plans that will encourage people to save water rather than to use more of it. Victory garden rebates would not fit into such plans, in fact, would be entirely contrary.

(7) Finally, looking at it broadly, why should water companies either municipally or privately owned, subsidize the growing of vegetables? Granted that this is a very worthy cause, should the burden be placed on the water companies any more than on the seed growers, the implement manufacturers and retailers, the distributors of fertilizers? Even the manufacturers of outright war materials are not expected to operate without some profit. Water that is used on victory gardens is the same water that is used for all domestic purposes, has the same treatment and is delivered at the same pressure.

It certainly seems to savor of discrimination to attempt to fix a special rate for this one type of service, and usually, rather crudely to determine the quantity that can be granted this

special rate. Would it not be better for each utility to analyze its situation frankly? If it feels, and the records show, that its return is no more than adequate and that its water rates are fair, then why not stand on that and make concessions to no one? On the other hand, if business is so good that profits justify some reduction in rates, then it certainly would be fairer to most people to make the rate reduction applicable to all consumers. Certainly this would result in much less grief, confusion, and extra work on the part of an already hard-working and depleted water works staff.

SUPPLEMENTARY UTILITIES ORDER U–1–e, AS AMENDED JAN. 23, 1944

Victory Gardens

No material changes have been made in Supplementary Order U–1–e relating to Victory Gardens, in the U–1 Series amended January 22, 1944. ***[See p. 250 this Journal; p. 685–686 May, 1943 Journal.]***

§ 4500.6 *Supplementary Utilities Order U–1–e.* In accordance with the provisions of paragraph (i) of Utilities Order U–1, water service extensions of not more than 250 feet (including any portion built by or for the consumer) may be made or connected by producers to provide water for gardens, when all of the following conditions are satisfied:

(a) There is no alternative source of water which would require less critical material.

(b) Water from each such extension will be used to provide water for not less than 5,000 square feet of land devoted to the production of edible crops.

(c) Extensions are made with not more than 5 feet of pipe for each 500 square feet of cultivated land.

(d) Pipe of the smallest practicable size, and in no event having a nominal inside diameter greater than 1¼", is used.

(e) No copper or copper base alloy pipe or tubing is used.

(f) No extension or enlargement of mains is required.

(g) The consumer agrees in writing with the producer that his use of water for the purposes of this supplementary order will be subject to rules promulgated by the producer in the interest of water conservation, including requirements for off-peak usage and interruption of service during periods of water shortage.

Issued this 22d day of January 1944.

WAR PRODUCTION BOARD,
By J. JOSEPH WHELAN,
Recording Secretary.

Some New Features in the Design of Vertical Flocculation Units

By Charles Gilman Hyde and Harvey F. Ludwig

MECHANICALLY induced or improved flocculation by the use of revolving paddles has been widely utilized in rapid sand filter plants since shortly after its first and successful application in 1924 (the designs were made in 1921) by W. F. Langelier and one of us at Sacramento (1, 2). The Sacramento designs were preceded by laboratory experiments conducted by Professor Langelier beginning in 1919. In performing those experiments he developed the laboratory stirrer (jar test) which is now so generally employed in determining chemical dosages and efficiencies in connection with coagulation.

The actual design factors for the Sacramento flocculation units were in part developed by pilot plant tests. The pilot plant employed three galvanized sheet-steel circular tanks in series arranged for downward spiral flow. The tanks were each 25 in. in diameter and had a vertical wall depth of 15 in., 3 in. being allowed for freeboard. The tanks had dished bottoms and were calculated to have an effective depth of about 13 in. and a holding capacity of 28 gal. each.

A contribution by Charles Gilman Hyde, Consulting Sanitary and Hydraulic Engr., Berkeley, Calif., and Harvey F. Ludwig, Asst. Sanitary Engr., U.S. Public Health Service.

The Sacramento treatment plant includes four vertical circular concrete flocculation tanks, operating in series. Each tank has an inside diameter of 44 ft., a designed water depth of 23 ft., and a designed freebroad of 18 in. The total designed holding capacity of the four units, with their connecting conduits, is about 1,100,000 gal., representing a theoretical flowing-through period of nearly 50 min. for the nominal capacity of the filter plant, 32 mil.gal. per 24 hr. The tank assembly appears to have been operated with an average water depth of 22.5 ft. (2).

The raw water supplied to the tanks is degritted in a grit and storage basin of unique design. Immediately prior to its entrance into the flocculation tanks the raw water is dosed with alum syrup manufactured at the plant. Provision is made for additional dosage between the second and third tanks. Water enters the first tank at the bottom, the second at the top, and so on, finally leaving the fourth tank at the bottom whence it proceeds to three sedimentation basins which can be operated in series, with any one or two or all three in use, or all by-passed, as may be desired.

A cross-section showing a typical flocculation unit at Sacramento, as designed in 1921 and placed in operation in 1924, appears on page 95 of the

Manual of Water Quality and Treatment (American Water Works Association, 1940). This drawing first appeared in a paper by Carl M. Hoskinson entitled "Mixing" (2).

The design factors for the paddles were as follows:

Number of paddle blades per tank	10
Area of paddle blades per tank, sq.ft.	250
Per cent of cross-sectional area of tank represented by paddle blade area	25
Extreme diameter of paddle assembly, ft.	32.5
Center of gravity of paddle assembly:	
From center line, horizontal distance, any 5 paddle group, ft.	9.67
From tank bottom, vertical distance, ft.	9.13
Per cent, paddle diameter to tank diameter	74
Energy center, any 5 paddle group, from center of shaft, ft.	12.75
Cubic ft. of tank capacity per sq.ft. of paddle area	140

The paddles are made of flat steel plates 30 in. wide and 0.25 in. thick. They are hung from two horizontal arms in direct alignment attached to a vertical revolving shaft in each tank. The type of suspension used permits the blades to swing backwards thus reducing the starting torque. Each shaft is turned by a reciprocating water engine with an oscillating cylinder supported on vertical trunions. These engines, designed by B. F. Raber, are still functioning as admirably as ever, after nearly 20 yr. of service. Any reasonable peripheral speed in any tank may be obtained and uniformly maintained. The design visualized mean rotative velocities, feet per second, of the water masses in the several tanks as follows: No. 1, 2.0; No. 2, 1.5; No. 3, 1.0; No. 4, 0.5.

An important feature of the Sacramento flocculation tank design, tending to reduce greatly the tendency toward short circuiting, is the introduction into and removal of the water from the tanks in thin sheets flowing in the direction of motion (revolution) in each tank. This is accomplished at the bottoms of the tanks by slots and deflecting aprons and at the tops by relatively wide tangential channels of small height. Thus a rotational effect is produced in the water masses independently of the paddle action.

It can be stated unequivocally that the Sacramento flocculation tanks have been uniformly successful in producing large, dense, rapidly settling flocs from sulfate of alumina syrup. This result has been achieved with minimal coagulant dosages which have effected a very large aggregate saving in the cost of treatment as compared with earlier practice.

It is believed that the great majority of later designs to date have employed flat paddle blades, their dimensions and spacing varying widely according to the rotative speed and other factors. However, in three California plants, namely, Upper San Leandro, Oakland, 1925, Beverly Hills, 1927, and the Chenery Plant at Clyde, 1929, the paddle assembly is a solid panel, relatively tall and narrow, slightly curved backward in horizontal section, and fixed in vertical position; i.e., the blade or blades are not free to swing from top hinged supports. (*See* Fig. 1.) In these designs the ratio of paddle diameter to tank diameter is of the order of one to four. The object of this design was to produce the maximum allowable spiral velocity of 2 fps. close to the center of rotation. It was the belief that gentle swirls would form at the periphery of the paddle assem-

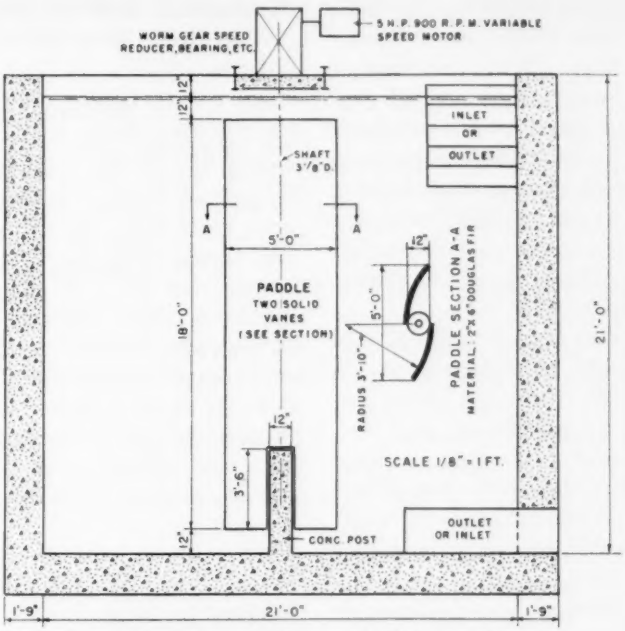


FIG. 1. TYPICAL SECTION THROUGH VERTICAL CIRCULAR FLOCCULATION TANK OF UPPER SAN LEANDRO WATER TREATMENT PLANT, OAKLAND, CALIFORNIA

DESIGNED PADDLE SPEED, 15 REVOLUTIONS PER MINUTE.
TANK ASSEMBLY COMPRISES 4 UNITS.

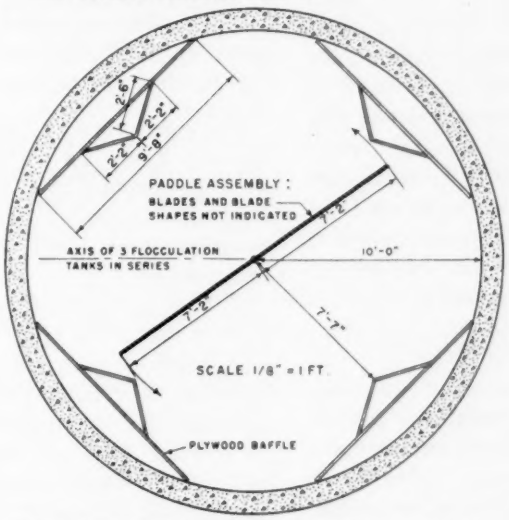


FIG. 2. POSSIBLE ADAPTATION OF ALCOVE EFFECT IN VERTICAL CIRCULAR FLOCCULATION TANKS AT MARTINEZ, CALIFORNIA, BY THE USE OF PLYWOOD DEFLECTORS.
REINFORCEMENT AND ANCHORAGES NOT SHOWN.
DEFLECTORS OF 3/4 INCH 5-PLY WATERPROOF PLYWOOD.

bly and move outwardly to the sides of the tank. The paddle speed (rpm.) is relatively high. With this type of paddle, care must be exercised that the rotational speed and consequent peripheral velocity be not so great as to destroy the floc rather than build it up. Such a result occurred with the so-called "spiro-vortex" pump stirrers installed in additional flocculation tanks at Sacramento in 1933 (2).

Prior to the introduction of the Langelier method of induced and improved flocculation through gentle agitation by mechanical means, and even for a long time afterward in some quarters, it was the belief that violent mixing of the coagulant with the water was all that was necessary to secure optimum, or at least satisfactory results when followed by subsidence in typical sedimentation basins.

First Application

The application of mechanical flocculation to raw sewage, without the use of chemicals, was first made at San Francisco by Benjamin Benas who employed vertical paddles in experiments conducted at the activated sludge process treatment plant in Golden Gate Park in 1933 (3). This procedure is now being utilized at a number of places in the United States.

Purpose of Present Discussion

Both vertical and horizontal flow flocculation tanks or basins are now in use, each type having its own particular merits.

It is the purpose of this discussion, not to compare the relative merits of the two kinds of tanks, but to describe certain improvements which can readily be incorporated into designs of tanks of the vertical flow type.

Mechanical Aid to Flocculation—The Underlying Principle and Effects

To obtain the maximum effect of any coagulant in the clarification of a turbid water, the chemical must be coagulated in such manner as to produce the largest possible mass of stable, fast-settling floc. The procedure of building up large non-fragile floc masses is known as floc conditioning. It normally involves turbulent motion in channels or chambers whereby the floc particles are constantly being brought into gentle contact or collision with one another until the maximum possible degree of coalescence has been brought about.

The criteria of a good floc are size, specific density, and toughness, all tending to produce rapid subsidence and a satisfactory degree of clarification, preparatory, in the normal case, to rapid sand filtration.

The Sacramento studies and experiments of 1919–1921 led to the following conclusions, among others:

1. Mean rotative water velocities ranging from 1.5 to 2.0 fps. in the first or primary tank of a series are valuable in causing a rapid mixing of coagulant and water and in starting flocculation.

2. Mean rotational velocities much greater than 1.5 fps., if prolonged, have a tendency to reduce, rather than increase, floc sizes (with sulfate of alumina as a coagulant).

3. Velocities lower than 0.5 fps. are not highly effective in producing satisfactory floc masses.

4. With a number of tanks in series, a progressive decrease in mean rotational velocity from the first to the last tank produces the best results, judged by the criteria stated above.

5. A theoretical flowing-through period of 40 min. at the rated capacity of a typical rapid sand filter plant (125 mil.gal. per acre per 24 hr.) is highly satisfactory with tanks carefully designed to reduce short-circuiting.

6. The subsiding velocity of good floc is about 0.1 fps.

Corroborative Findings

Nolte and Kramer (4) at St. Louis, circa 1933, conducted a noteworthy series of investigations, using sulfate of alumina as a coagulant, on the velocity and time of floc conditioning. Their findings, generally corroborative of the early Sacramento work, were in part as follows (5):

1. Good results can be obtained with velocities ranging from 0.5 to 1.5 fps. through a period of 30 min., provided that the dosage of coagulant is sufficient.

2. Velocities greater than 1.5 fps. for any time period from 1 to 60 min. give poor results.

3. Mixing in water at a high velocity followed by conditioning at 1.0 fps. give results comparable with uniform velocities of any value between 0.5 and 1.5 fps. for the same period of time.

4. The higher the charge of coagulant (in their case, aluminum sulfate) the more rapidly is the floc formed; lower charges will require longer periods of conditioning, but a deficiency in dosage cannot be compensated by prolonged periods of conditioning.

The Sacramento results have been further corroborated by Hoover (6) at Columbus, Cox (7) at Reading, Willcomb (8) at Albany, Leipold (9) at Winnetka, and by others elsewhere at various times (10).

Recent Design of Flocculation Tanks for Martinez, California

On general principles, it would appear that gentle eddy currents should assist in floc agglomeration and that such currents might be developed more effectively than past practice has recognized, by two co-operating methods: first, by employing paddles of cross-sectional shape other than plane or flat; second, by providing alcoves along the interior walls of the flocculation tanks, especially if the tanks are circular.

The energy which is imparted to a body of liquid by a moving surface of tangible proportions is manifested primarily in two forms: (a) in the momentum of the mass; (b) in the production of eddy currents. As previously stated, it was demonstrated by Langelier and by others later that these eddies are necessary to optimum flocculation since they bring about the inter-particle collisions required for building up of the floc particles.

With a properly designed stirring mechanism, therefore, a significant portion of the applied energy should be expended in producing eddy currents. The energy necessary to produce and maintain momentum, with consequent translatory motion, must of course be furnished. Almost any shape of paddle will accomplish the latter effect; but the former, i.e., eddy currents, can best be developed by paddles whose blades are designed specifically with that end in view.

In plans recently completed for a water treatment plant for the City of Martinez, Calif., the writers have attempted to effectuate these considerations in the design of the flocculation tanks.

Six different cross-sectional shapes for the paddles were considered. These were: flat, ogee, inverted acute angle (60° ±) V, inverted obtuse angle (135° ±) (V to be set with one face parallel to the supporting arm) half-circle and half-hexagon. Certain of these were tested out by constructing small model frames each carrying several paddles of the particular shape. Fine filaments or threads were attached to the blade edges in order that the character and extent of the eddy currents produced could be visualized. For the sake of simplicity and ease of manipulation the frames were dragged through still water. The best shapes appeared to be the inverted acute angle V, the half-circle and the half-hexagon. Among these there was little choice from the hydraulic standpoint. The half-hexagon shape was adopted for the final design because it is comparatively easy to fabricate and to suspend, with adequate lateral stability, on supporting horizontal arms attached to a vertical rotating shaft. Thanks to modern welding methods, however, blades of any of the other shapes can readily be provided with suitable and satisfactory suspension members.

Three vertical circular concrete tanks in series constitute the flocculation tank assembly. In order to avoid short-circuiting to the maximum reasonable extent, each tank is divided in the center of its water depth by a timber bulkhead. The water is brought into or taken from, as the case may be, each of the six compartments through slots surmounted by discharging or receiving aprons directed toward the moving mass of water. It will be observed that these deflecting aprons face in reverse directions on opposite sides of the tank centers.

With six compartments, designed to function virtually as independent units, using the mathematical approach suggested by Langelier (1), the efficiency as related to short-circuiting, with stated theoretical retention periods in each compartment, would be as follows:

Min. Retention	%
3	87.9
6	91.3
9	92.2
12	92.7
15	92.7
18	92.7

The paddle assembly in each tank, therefore, consists of two halves, one in the lower compartment and one in the upper. Figure 5 shows the Martinez design for one typical tank. It is believed that the blade shape which has been chosen will maintain the necessary momentum and that the long, relatively narrow, vertical slots between the paddles will be regions of cross-currents promoting the formation of favorable eddies.

The design factors for the paddle assemblies proposed for the Martinez flocculation tanks are as follows:

Number of paddle blades per tank	24
Number of paddle blades per compartment	12
Gross area of paddle assembly per tank, *sq.ft.*	112.6
Projected area of paddle assembly per tank, *sq.ft.*	72.6
Cross-sectional water area of tank on any diameter, *sq.ft.*	235
Per cent of cross-sectional water area of tank represented by projected paddle blade area	30.9
Extreme diameter of paddle assembly, *ft.*	14.33
Per cent, paddle diameter to tank diameter	71.7
Center of gravity of paddle assembly in any compartment:	
From center line, any 6 paddle group	4.2
From compartment bottom	3.2

Energy center, any 6 paddle group, from center of shaft	5.6
Cubic feet of tank capacity per sq.ft. of projected paddle area	51
Proportion of tank area and of water volume within periphery of paddle revolution, per cent	51
Speed of paddles, rpm.:	
Tank No. 1	2.74
Tank No. 2	2.04
Tank No. 3	1.34

An inherent deficiency of the revolving vertical stirrer type mechanism is the pronounced change in tangential velocities of the paddle with increasing distances from the center. To offset this variation in some degree the paddle clearances in the Martinez design have been increased roughly in proportion to the distance from the central shaft.

Circular tanks with plain interior walls have served admirably in producing floc masses. However, to be consistent in the effort to develop eddy currents, and at the same time reduce the tendency to purely rotary motion, which is believed to be relatively ineffectual in generating such eddy currents, designs have been made of a modified clover-leaf type of construction which can readily be installed in the circular tanks of the proposed Martinez plant. This design in shown in Fig. 2.

It will be observed that the proposed construction is of waterproof plywood. This has been adopted because of its low cost. An unquestionably better, although more expensive, design would be one incorporating a true clover-leaf pattern in the concrete itself as indicated in Fig. 4. The only commercial adaptation of such a pattern, insofar as the writers are aware, is to be found in the Waring Blendor, a soft-drink mixing device. The clover-leaf pattern, or its approximation as proposed in the Martinez design, should increase the tank efficiency by minimizing mass rotary motion and by setting up instead a series of local eddy areas. Fig. 3 indicates a means of obtaining some such effect in a square tank. In any case, for reasons of economy, it is desirable that the alcoves giving the so-called clover-leaf pattern and effect shall not occupy too much capacity space or demand an excessive volume of concrete.

Some Observations on the Hydro-Mechanics of the Martinez Paddle Design

In order to provide in any design a sufficient but not excessive capacity of the driving motors, it is essential that the power demand of any paddle assembly be computed with a fair degree of accuracy. This power demand will obviously be greatest when the mass of water in a flocculation tank has a minimum initial velocity. It is to be noted that this cannot be zero in the Martinez design when the supply of water undergoing treatment is passing through the flocculation tanks, because the manner of its introduction and removal will produce spiral motion with a measurable velocity, this velocity increasing or decreasing directly with the unit-time quantity.

Power will be expended in at least five ways: (1) in producing or sustaining momentum in the liquid mass; (2) in producing eddy currents; (3) in overcoming the frictional resistance against the tank surfaces; (4) in overcoming the frictional resistances in motor, speed reduction devices and bearings; and (5) in producing heat through frictional resistances other than those represented in items (1) to (4). Some of these items can be calculated with a fair degree of assur-

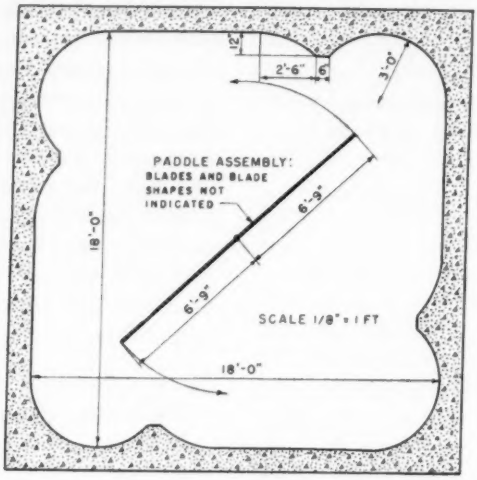


FIG. 3. POSSIBLE ALCOVE DESIGN FOR A SQUARE VERTICAL CONCRETE TANK OF APPROXIMATELY THE SAME CAPACITY AS THE CIRCULAR TANK SHOWN IN FIGURE 5

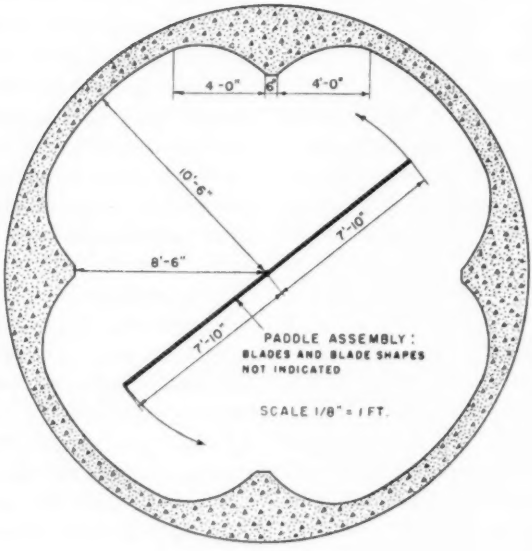


FIG. 4. POSSIBLE ALCOVE (CLOVER LEAF) DESIGN FOR A CIRCULAR VERTICAL CONCRETE TANK OF APPROXIMATELY THE SAME CAPACITY AS THE CIRCULAR TANK SHOWN IN FIG 5.

ance; others, such as (2) and (5), can probably only be guessed.

The writers have attempted to evaluate the drag of the paddle assemblies in the Martinez design under the following assumptions: (1) that the paddles, initially in a vertical position, are set in motion at full-rated rotational velocity in still water; (2) that, since the paddles are free to swing on their supporting arms, they will immediately be deflected at angles proportional to the instantaneous drag; (3) that the reduced projected paddle area, thus occasioned, will reduce the drag somewhat and therefore the deflection angles; (4) that there will be a subsequent temporary increase in the drag due to the slightly increased projected paddle area; (5) that there will follow a period of gradual adjustment during which both the deflection angles and the drag will be decreased as the mass of water in a tank acquires its full momentum, and energy is no longer required to produce acceleration; and (6) that the final angles of deflection and the drag will be those incident to the maintenance of the prescribed rotational velocity in the water mass, the attendant resistances being represented mainly by the production of eddy currents and by friction against the tank surfaces.

The drag (D) of paddles is represented by the formula $D = C_d w a (V^2/2g)$ (11) (12) (13) wherein C_d = the coefficient of drag as related to the size and shape of a paddle blade; w = the weight of a cubic unit of water; a = the projected area of the paddle normal to the direction of motion; and $V^2/2g$ = the velocity head. If the units employed are expressed as pounds, feet and seconds the drag will be expressed in pounds, and the horsepower can be computed by multiplying the drag by the proper velocity value and dividing the product by 550.

Since the velocity of each paddle and its corresponding drag are determined by the distance from the center of the rotating shaft, it is obvious from an inspection of the above formula that the drag must be computed separately for each paddle or group of paddles equidistant from a shaft center. The total drag for the paddle assembly will be the sum of the drags of its component parts.

It is proposed to develop and maintain general mean velocities of 1.5, 1.0 and 0.5 fps. in the first, second and third flocculation tanks, respectively, at Martinez.

Recognizing these various circumstances and conditions, computations have been made of the paddle drag in the three flocculation tanks proposed for the Martinez water treatment plant. In making these calculations C_d has been assumed to be 1.0 for the paddle shape and dimensions as designed for the Martinez plant. This figure will hold for all values of Reynolds Number pertinent to the conditions of paddle operation which will obtain in practice. As a matter of fact, if $C_d = 1.0$ for the paddle blades in a vertical position, it will probably be somewhat less if they are deflected backward, which will be the practical case, the greatest degree of deflection occurring with the outermost paddles and the least with those nearest to the central rotating and propelling shaft. The calculations show that the latter will have a negligible deflection at all times because of their low drag value. It will be on the safe side to assume a uniform value of C_d and that for paddles in a vertical position.

The friction of tank wall, floor and bulkhead surfaces may be calculated by

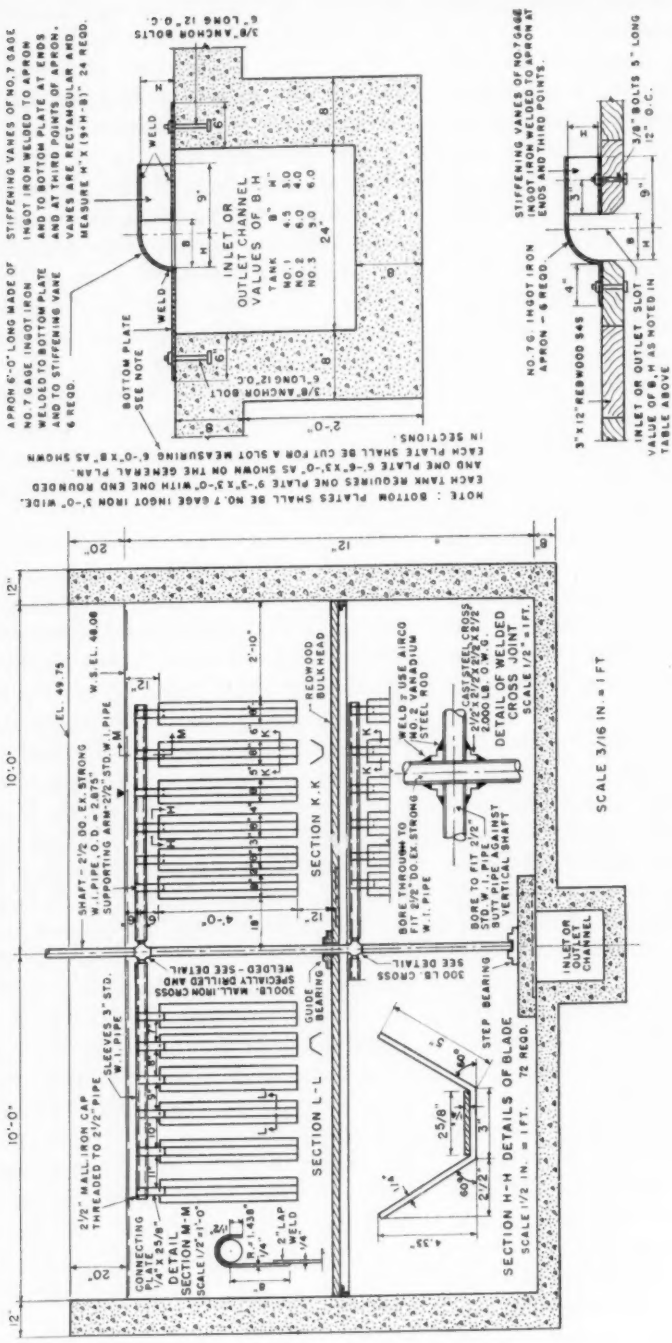


FIG. 5. VERTICAL SECTION THROUGH TYPICAL CIRCULAR CONCRETE FLOCCULATION TANK AS PROPOSED FOR THE MARTINEZ, CALIFORNIA, WATER TREATMENT PLANT
ALSO DETAILS OF DEFLECTOR APRONS ON FLOORS AND BULKHEADS.
NOTE: THREE FLOCCULATION TANKS ARE EMPLOYED IN SERIES, EACH TANK HAVING TWO COMPARTMENTS SEPARATED BY A TIMBER BULKHEAD AS SHOWN.
R P M OF PADDLES IN TANKS: NO. 1, 2.74; NO. 2, 2.04; NO. 3, 1.34.

TABLE 1

Paddle Assembly Drag and Electric Driving Motor Capacity for Proposed Flocculation Tanks, Martinez, California

Item	Tank No. 1	Tank No. 2	Tank No. 3
Peripheral Velocity of Paddles, *fps*	2.0	1.5	1.0
Speed of Paddle Assembly, *rpm*	2.74	2.04	1.34
First Paddle Position (Total Drag), *lb*	124.	70.	31.
hp	0.36	0.15	0.04
Second Paddle Position (Total Drag), *lb*	119.	70.	31.
hp	0.34	0.15	0.04
Third Paddle Position (Total Drag), *lb*	122.	70.	31.
hp	0.35	0.15	0.04
Normal Running Position (Total Drag), *lb*	36.	13.6	3.4
hp	0.10	0.03	0.004
Efficiency of Driving Mechanisms, %	57.	57.	58.
Resulting Required Motor Capacity, *hp*	0.63	0.26	0.07
Motor Capacity as Specified, *hp*	0.75	0.50	0.50
Specified Reduction Rating of Speed Reducer	634.	852.	1,296.
Specified Maximum Torque, *in.-lb*	14,300.	14,300.	16,500.
Specified Maximum Thrust, *lb*	4,215	4,215	4,215

Note: The induced spiral flow consequent upon the manner of bringing the water into the tanks will measurably reduce the maximum drag and corresponding torque.

The efficiency figures for the driving mechanisms attempt to recognize varying values of motor, reduction gear and bearing efficiencies; but the resulting over-all estimated values are remarkably similar.

the formula $R = nfSV^2$ where $R =$ the total resistance of a given area in pounds; $n =$ a factor to represent losses due to eddy currents, paddle slip, etc.; $f =$ the frictional resistance factor related to the character of the contact surface; $S =$ the area of the surface in square feet; and $V =$ the velocity of the water mass, expressed in feet per second, against the contact surface S. A suitable value of f for concrete surfaces would appear to be 0.005 (13) and for surfaces of wood 0.004. The value of n can only be conjectured. It will probably increase according to some function of V. For the present purposes it has been assumed to be 2.0 for the conditions in Tank No. 1, 1.6 for those in Tank No. 2 and 1.3 for those in Tank No. 3. Since R varies directly with V^2, its accurate computation suggests the necessity of determining the value of V for different portions of the contact area. The horsepower represented by these partial resistances may be calculated by multiplying each by the respective velocity and dividing the sum of those products by 550.

In order to obtain the corresponding motor output it will be necessary to recognize the efficiencies of the motor, reduction gearing and bearings.

The results of the computations for the Martinez design are presented in Table 1.

References

1. Langelier, W. F. Coagulation of Water With Alum by Prolonged Agitation. Eng. News-Rec., **86**: 924 (1921).
2. Hoskinson, C. M. Mixing. Jour. A.W.W.A., **28**: 1552 (1936).

3. HYDE, C. G. *A Review of Progress in Sewage Treatment During the Past Fifty Years in the United States.* Fed. Sewage Works Assn., New York (1938); Chapter 1, "Modern Sewage Disposal."
4. NOLTE, A. G. & KRAMER, W. A. Coagulation With Aluminum Sulfate. Jour. A.W.W.A., **25**: 1263 (1933).
5. HYDE, C. G. Practical Aspects of Coagulation With Ferric Chloride. Jour. A.W.W.A., **27**: 631 (1935).
6. HOOVER, C. P. Mixing Devices and Reaction Time. Jour. A.W.W.A., **11**: 582 (1924).
7. COX, C. R. Alum Agitation Studies at Reading, Pennsylvania. Eng. News-Rec., **93**: 101 (1924).
8. WILLCOMB, G. E. Floc Formation and Mixing Basin Practice. Jour. A.W.W.A., **24**: 1416 (1932).
9. LEIPOLD, C. Mechanical Agitation and Alum Floc Formation. Jour. A.W.W.A., **26**: 1070 (1934).
10. *Water Treatment Plant Design.* A.S.C.E. Manual of Engineering Practice, No. 19 (1940).
11. RUSSELL, G. E. *Hydraulics.* H. Holt & Co., New York (1937).
12. PRANDTL, L. & TIETJENS, O. G. *Applied Hydro- and Aero-mechanics,* McGraw-Hill Book Co., Inc., New York and London (1934); Chapter 5, "Drag of Bodies Moving Through Fluids."
13. GIBSON, A. H. *Hydraulics and Its Applications.* D. Van Nostrand Co., New York (1920).
14. ROUSE, H. *Fluid Mechanics for Hydraulic Engineers.* McGraw-Hill Book Co., Inc., New York and London (1938).
15. DODGE, R. A. & THOMPSON, M. J. *Fluid Mechanics.* McGraw-Hill Book Co., Inc., New York and London (1937).
16. O'BRIEN, M. P. & HICKOX, G. H. *Applied Fluid Mechanics.* McGraw-Hill Book Co., Inc., New York and London (1937).

Resistance Coefficient Calculation From Incremental Flow Measurement

By Ross E. Thompson

MEASUREMENTS of the resistance coefficient of underground water lines and of the actual quantity of water flowing may be made indirectly by the simple expedient of drawing off a measured flow through some convenient outlet such as a fire hydrant and at the same time measuring the pressure head loss in the piping during the time measured flow is being drawn off.

If we could assume that the original flow X, plus the incremental flow, would continue through the pipeline the problem would be very simple. The actual problem is not quite so simple, however, for the reason that in any grid system where two or more pipes are connected in parallel we cannot assume that the original flow will not change when the incremental flow is drawn off. In fact, we may be certain that it will change. For this reason we must take into consideration two lengths of piping with no other outlet or inlet flows between points of measurement, one length above and one length below the point of measured incremental takeoff.

With piping essentially as shown in the above sketch (Fig. 1), we will not try to assume the original flow, but will designate the incremental flow as I, the flow in the lower pipe (while taking off the flow I) as X, and the flow in the upper pipe as $X + I$.

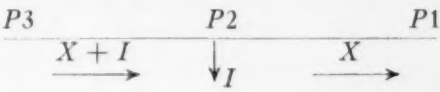


FIG. 1

The relative values of the resistance coefficient in the two sections of pipe will be definitely known by comparison of the head pressure loss per 1000 ft. of pipe in each section, with no incremental flow being drawn off, in other words, with the same flow of water in each section of piping.

Any extreme difference between the two sections further complicates this method of calculation, but with the same condition in each of the two sections, or with relatively small differences in conditions, by these calculations we arrive at the average Hazen-Williams C value, in a very practical manner.

In actual practice it will not be necessary that the two lengths of pipe be exactly 1000 ft. long, nor that they be of equal length. The exact length of either section is of no importance, except that it must be known, and pressure head losses in each section must be measured and stated in terms of

A paper contributed by Ross E. Thompson, Mechanical Engineer, New York, N.Y.

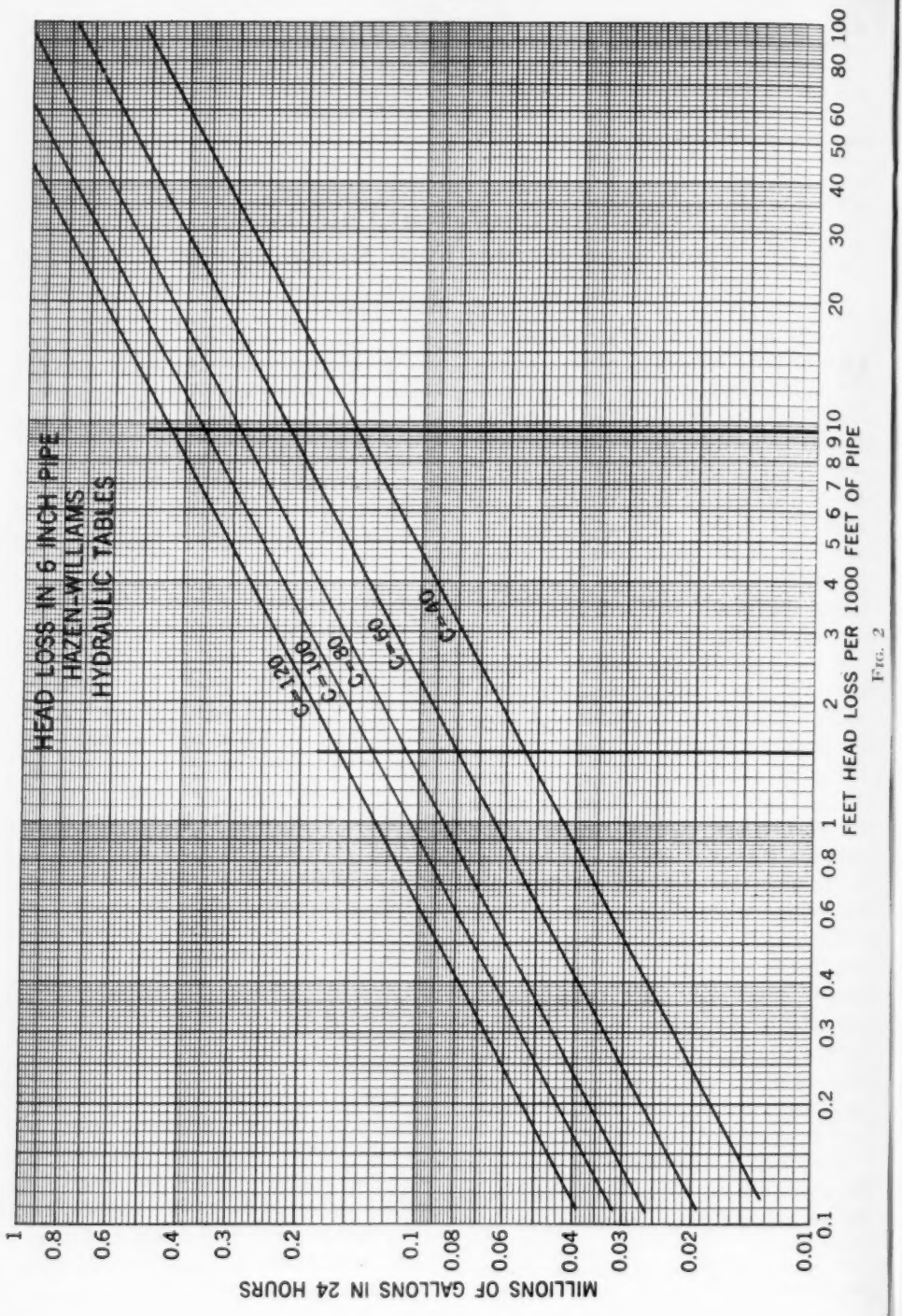

HEAD LOSS IN 6 INCH PIPE
HAZEN-WILLIAMS
HYDRAULIC TABLES
C=140
C=120
C=100
C=80
C=60
C=40
MILLIONS OF GALLONS IN 24 HOURS
1
0.8
0.6
0.4
0.3
0.2
0.1
0.08
0.06
0.04
0.03
0.02
0.01
0.1
0.2
0.3
0.4
0.6
0.8
1
2
3
4
5
6
7
8
9
10
20
30
40
50
60
80
100
FEET HEAD LOSS PER 1000 FEET OF PIPE

Fig. 2

feet head loss per 1000 ft. of pipe before applying these calculations.

Suppose that, the above pipe being a 6-in. pipe, before taking off the incremental flow we find the head loss $P3 - P2 = 2.5$ ft. and the head loss $P2 - P1 = 2.5$ ft. per 1000 ft. of pipe. Assume that we open a hydrant at $P2$ and measure the flow from the hydrant and find it to be 90 gpm. or .13 mgd.

Again measuring the head loss we now find $P3 - P2 = 9.5$ ft. and $P2 - P1 = 1.5$ ft. With these readings we turn to the hydraulic chart for 6-in. pipe and draw vertical lines as shown in Fig. 2, from the abscissa scale at 1.5 and 9.5 to cut the C40 graph (or any C graph). Place a separate work sheet on the chart, as shown in Fig. 3, and mark on the margin of the work sheet the height at which the C40 graph is seen to cut through these two vertical lines, marking on the work sheet these two points X, and $X + I$. The vertical distance on the work sheet between these two points must now represent the incremental flow of .13 mgd. and by trial along the ordinate scale we are able to find a place in which this value of the vertical distance will fit into the ordinate scale, which in this particular example is found to be $X = .077$, and $X + I$ equals .207. These points should be marked on the ordinate scale as indicated on Fig. 3 and horizontal lines drawn to cut the vertical lines previously drawn from the abscissa scale as shown in Fig. 4. Mark the point where the .207 horizontal line cuts the 9.5 vertical line and the point where the .077 horizontal line cuts the 1.5 vertical line. These two points of intersection are now connected by a straight line which is found to be parallel to the graphs representing various C values of the 6-in. pipe and by its distance on the chart as compared with the other graphs, we may estimate fairly closely the C value indicated.

In this example we estimate the C value to be 56.

As will be seen, this determination is independent of the amount of the original flow or of how much it may change when the incremental flow is taken off.

Accurate corrections must, of course, be made for any difference in elevation when making these measurements. Probably the best possible arrangement will be to use a differential pressure gage on each section of the pipe, using sufficient length of small pipe, tubing or ordinary garden hose to connect such a gage to both ends of the pipe section. The next best arrangement will be to set up three ordinary pressure gages at one point, making the distant connections by means of a small pipe, tubing or hose. With this arrangement of instruments it will be possible to read pressures at three points practically instantaneously, and it will be necessary to make such readings instantaneously for the reason that the pressures in a water distribution system will be found to vary continuously. In the ordinary use of water such variations are not detected, but will be very objectionable when taking precise readings such as will be required for these tests. If it is not possible to have all readings made from one station by either of the above plans, it will, of course, be necessary to have a man stationed at each of the three stations and have all readings made simultaneously on pre-arranged signals. Pressures at the point $P2$ should be taken directly from the pipeline, and not from the hydrant from which the incremental flow is taken, as

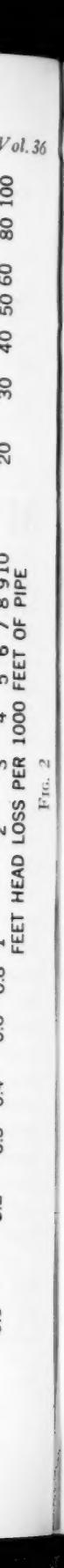


FIG. 2

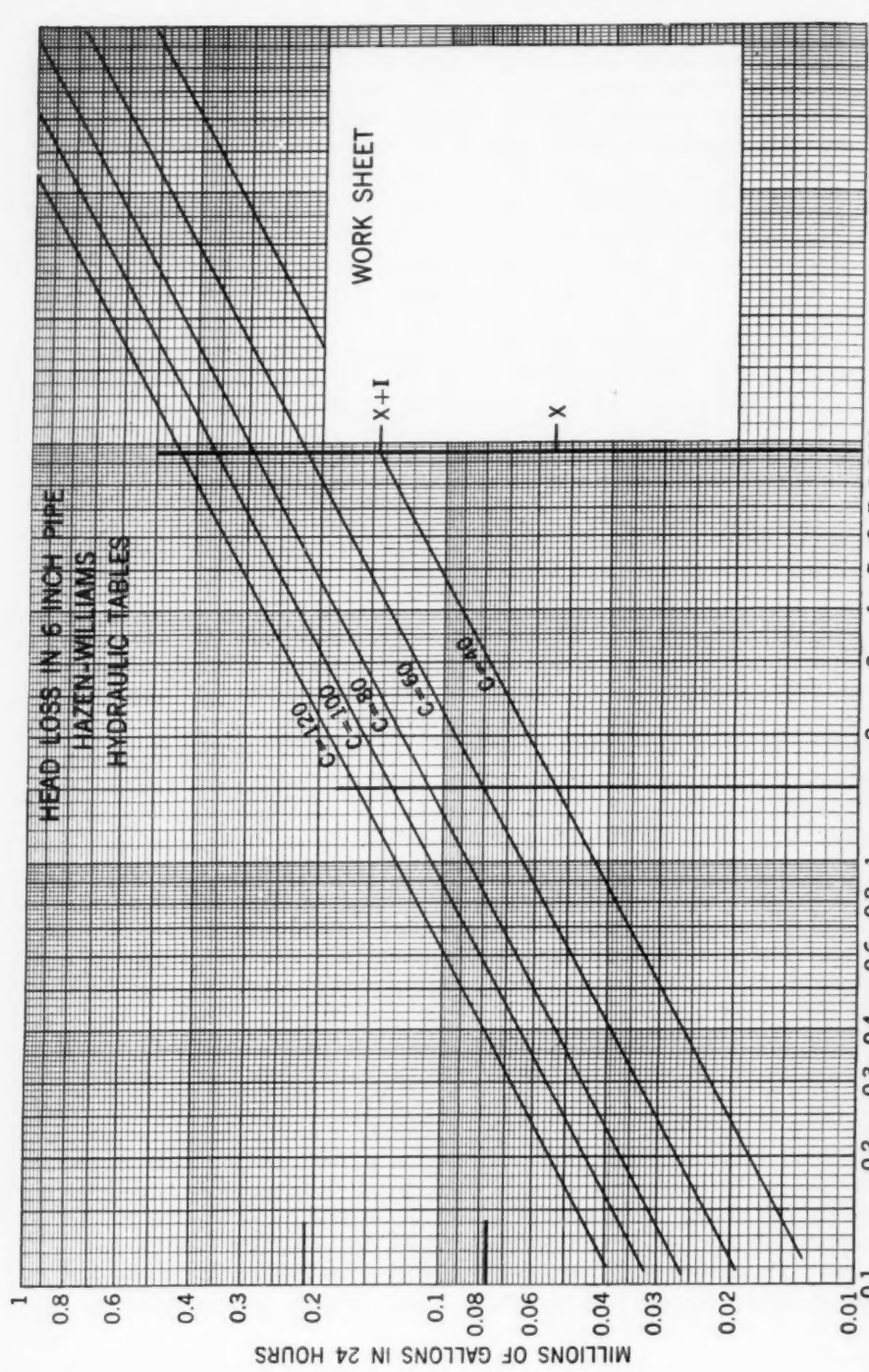

HEAD LOSS IN 6 INCH PIPE
HAZEN-WILLIAMS
HYDRAULIC TABLES
WORK SHEET
X+I
X
C=120
C=100
C=80
C=60
C=60
MILLIONS OF GALLONS IN 24 HOURS
FEET HEAD LOSS PER 1000 FEET OF PIPE
1
0.8
0.6
0.4
0.3
0.2
0.1
0.08
0.06
0.04
0.03
0.02
0.01
0.1
0.2
0.3
0.4
0.6
0.8
1
2
3
4
5
6
7
8
9
10
20
30
40
50
60
80
100

FIG. 3

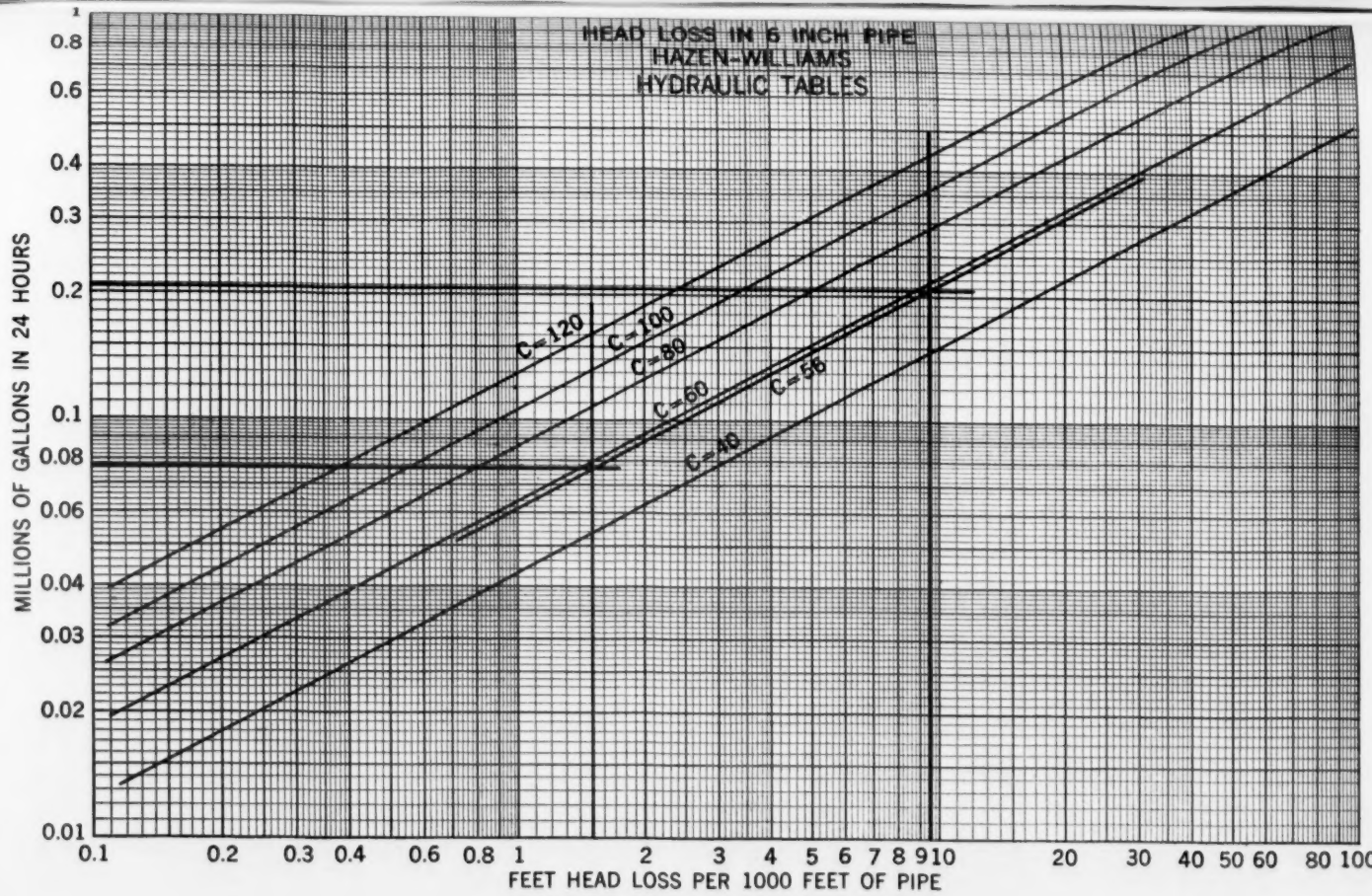

HEAD LOSS IN 6 INCH PIPE
HAZEN-WILLIAMS
HYDRAULIC TABLES
C=120
C=100
C=80
C=60
C=56
C=40
MILLIONS OF GALLONS IN 24 HOURS
1
0.8
0.6
0.4
0.3
0.2
0.1
0.08
0.06
0.04
0.03
0.02
0.01
0.1 0.2 0.3 0.4 0.6 0.8 1 2 3 4 5 6 7 8 9 10 20 30 40 50 60 80 100
FEET HEAD LOSS PER 1000 FEET OF PIPE

Fig. 4

that would, of course, include the head loss through the hydrant.

With the established C value at 56 and the original head loss of 2.5 ft. per 1000 ft., it is a simple matter to refer again to the chart and read the original flow at .1 mgd. or 70 gpm.

The same results can be obtained by using the formula:

$$\frac{X+I}{X} = \left(\frac{P_3 - P_2}{P_2 - P_1}\right)^{0.54}$$

Flow from a hydrant may be measured by flowing through a fire hose into a barrel while timing with a stop watch, or more conveniently and quickly by use of the piezometer. The hydraulic chart may be prepared for any size pipe, by using logarithmic paper and simply plotting a few points as read from Hazen-Williams Hydraulic Tables. Connecting C graphs as seen are straight, parallel lines.

This method may be applied in exactly the same way for the testing or calibration of large water meters.

The testing of a large water meter in service, particularly meters of the impeller type, is a very difficult problem for the water distribution system operator and this method of testing may be a valuable addition to his bag of tricks.

While this method is graphic, and requires no tedious calculations, it is based on the definite relation between the total head loss and incremental head loss and is precise enough for any requirements ordinarily encountered. It will give a very reliable indication of actual gallons per minute flowing in the pipe and of the actual numerical value of the resistance coefficient C as used in the Hazen-Williams formula.

Ground-Water Investigations in Florida
(*With Special Reference to Duval and Nassau Counties*)

By H. H. Cooper, Jr.

CONSUMPTION of ground water in Florida is increasing more rapidly than ever before. Municipal water supplies are being expanded to meet the requirements of growing populations; many large industries, especially pulp mills, are using as much water as Florida's largest cities; air conditioning units consume increasingly large quanties of ground water each summer; and many military establishments, some requiring millions of gallons each day, are drawing heavily on ground-water sources in all parts of the State. Further increases in consumption are expected. Although Florida's ground-water resources are as abundant as those of any other state, expansion of existing supplies and developments of new supplies can be wisely and safely planned only after careful studies of the ground-water resources have been made. This is true especially where over-draft can cause salt-water contamination of the ground-water supply and where pollution is entering the water-bearing formations through drainage wells or is seeping into the formations from surface sources.

The purpose of this paper * is to give some of the results of ground-water investigations in Florida, with special reference to those that have been made in Duval and Nassau Counties, and to describe briefly some of the methods and concepts used in these investigations.

The investigations are made under a cooperative agreement between the Florida Geological Survey and the Water Resources Branch of the Federal Geological Survey. They are under the direction of O. E. Meinzer, geologist in charge of the division of ground water of the Federal Geological Survey; Herman Gunter, Director of the Florida Geological Survey; and V. T. Stringfield, geologist in charge of ground-water investigations in the southeastern states. The author is indebted to Messrs. Meinzer, Gunter, and Stringfield for their helpful advice and suggestions. He is also indebted to L. K. Wenzel, M. A. Warren, W. D. Collins, and S. K. Love, of the Federal Geological Survey, for reviewing the paper. Mr. Robert B. Campbell also reviewed the paper and gave helpful editorial criticism.

A contribution by H. H. Cooper, Jr., Engineer in Charge of Ground-Water Investigations in Northern Florida for the U.S. Dept. of the Interior, Geol. Survey, Tallahassee, Fla.

* Published with the permission of the Director of the Geol. Survey, U.S. Dept. of the Interior, and the Director of the Florida Geol. Survey.

The author is indebted to Mr. O. Z. Tyler, Mr. R. L. McCall, and Mr. L. D. St. John, of the City of Jacksonville, for their generous assistance on work in Jacksonville, and to Dr. A. P. Black for his assistance on several of the pumping tests in Duval County.

The piezometric surface in Georgia was mapped by Mr. Warren (1) in cooperation with the Georgia Division of Mines, Mining and Geology, and that in Florida was mapped by Mr. Stringfield (2) in conjunction with the investigations in cooperation with the Florida Geological Survey. The portion of the piezometric surface in Duval and Nassau Counties, Florida, showing details of the cones of depression around areas of heavy draft, was mapped by the writer in 1940.

Early Studies

The need for studies of the ground-water resources was realized near the beginning of the century. Early interest in ground water is indicated by the fact that the first bulletin (3) of the Florida Geological Survey, published in 1908, was a report on the ground water of central Florida. By 1913 the Florida Geological Survey had extended its studies of ground water to almost all parts of the State, the results of these studies being included in the 3d, 4th, and 5th, annual reports (4). A comprehensive report on ground water of the entire State, by Matson and Sanford (5), was published in 1913. In 1927 an unpublished report on ground water at Jacksonville was made by Pirnie (6). A discussion of the quality of waters of Florida and analyses of water from wells throughout the State are included in a report by Collins and Howard (7). A report on the need for conservation of Florida ground water by Gunter and Ponton (8) was published in 1931. The results of an independent study of ground water in Seminole County by Stubbs (9) was published in 1937.

Cooperative Studies

By 1930 much general information had been accumulated on the ground water of Florida, and the need for more detailed quantitative and qualitative studies was apparent. More specific information was needed regarding (1) the location and the extent of areas in which the artesian water is recharged and discharged naturally; (2) the storage and water-transmitting properties of water-bearing formations; (3) fluctuations of water levels over long periods for study in conjunction with records of rainfall and withdrawal; (4) the danger of salt-water encroachment at places where large quantities of water are being withdrawn next to bodies of sea water; (5) the extent of pollution where drainage wells are used to dispose of waste matters. In order to conserve Florida's ground-water resources and promote wise development of ground-water supplies, the Florida Geological Survey and the Federal Geological Survey, through a cooperative agreement, began a program of ground-water studies in 1930.

As part of this program, field studies were made in several counties in Florida during the summers of 1930, 1931, and 1932 by V. T. Stringfield, and the results of these studies were published in 1933 and 1934 by the Florida Geological Survey (10). A paper by Stringfield (2), published in 1936, gave the results of a general investigation of artesian water in the Florida peninsula. This investigation made available a map of the piezo-

metric surface of artesian water in the peninsula, and made known for the first time the location of several major areas of recharge and discharge. In 1939 the Federal and State Geological Surveys began a detailed investigation of the water resources of southeast Florida in cooperation with Dade County and the cities of Miami, Miami Beach, and Coral Gables. A progress report (11) on this investigation was prepared in 1941, and a paper by Cross and Love (12), outlining the preliminary results, was published in 1942. Also, other results of this investigation were given in a paper by Parker (13) in 1942. An investigation of ground water in Escambia County was made in 1939–40 by the Federal and State Geological Surveys in cooperation with the Municipal Advertising Board of the City of Pensacola, and a report on the results of this investigation was prepared in 1940. An investigation of artesian water in northeast Florida was made in 1941 and 1942, and some of the results of this investigation were published (1) in 1941. Comprehensive reports on the investigations in southeast Florida and northeast Florida will be published in the future. Also, a paper, "Artesian Water in Florida West of the Suwanee River," by V. T. Stringfield and F. C. Westendick, prepared as a companion to the paper, "Artesian Water in the Florida Peninsula," has been completed for publication.

Studies in Duval and Nassau Counties

Duval and Nassau Counties, in northeast Florida, are a part of one of the most productive artesian areas in the United States, and in recent years large quantities of artesian water have been developed in these counties for industrial use. Because of these large developments, and because additional large supplies probably will be needed in the future, an investigation has been made to determine the quantity of water available.

Geologic Formations

The principal source of water is a thickness of 800 ft. or more of permeable limestones of upper and middle Eocene age, consisting of the Ocala limestone and other Eocene limestones that underlie the Ocala. The Ocala and associated Eocene limestones crop out in an irregular belt north, northwest, and west of the coastal area of Georgia and in north central Florida. In Duval and Nassau Counties the top of the Ocala lies from 250 to 550 ft. below sea level. A limestone tentatively identified (14) as Tampa limestone of Miocene age overlies the Ocala near the town of Hilliard, Nassau County, but this limestone probably will not yield a considerable quantity of water. However, at some places in Florida the Tampa limestone yields water in large quantities. In this paper all limestones that are closely related hydrologically to the Ocala, including some of the Eocene limestones that underlie the Ocala, and the Tampa and Marianna limestones that overlie the Ocala at some places in Florida, are considered as one hydrologic unit and will be referred to as "the artesian aquifer" or "the aquifer."

Overlying the Ocala limestone in Duval and Nassau Counties is the Hawthorn formation of Miocene age, which consists chiefly of layers of limestone, marl, clay, and sand. This formation is at or near the surface and ranges from 250 to 550 ft. in thickness. The relatively impervious layers of clay and marl in the Hawthorn for-

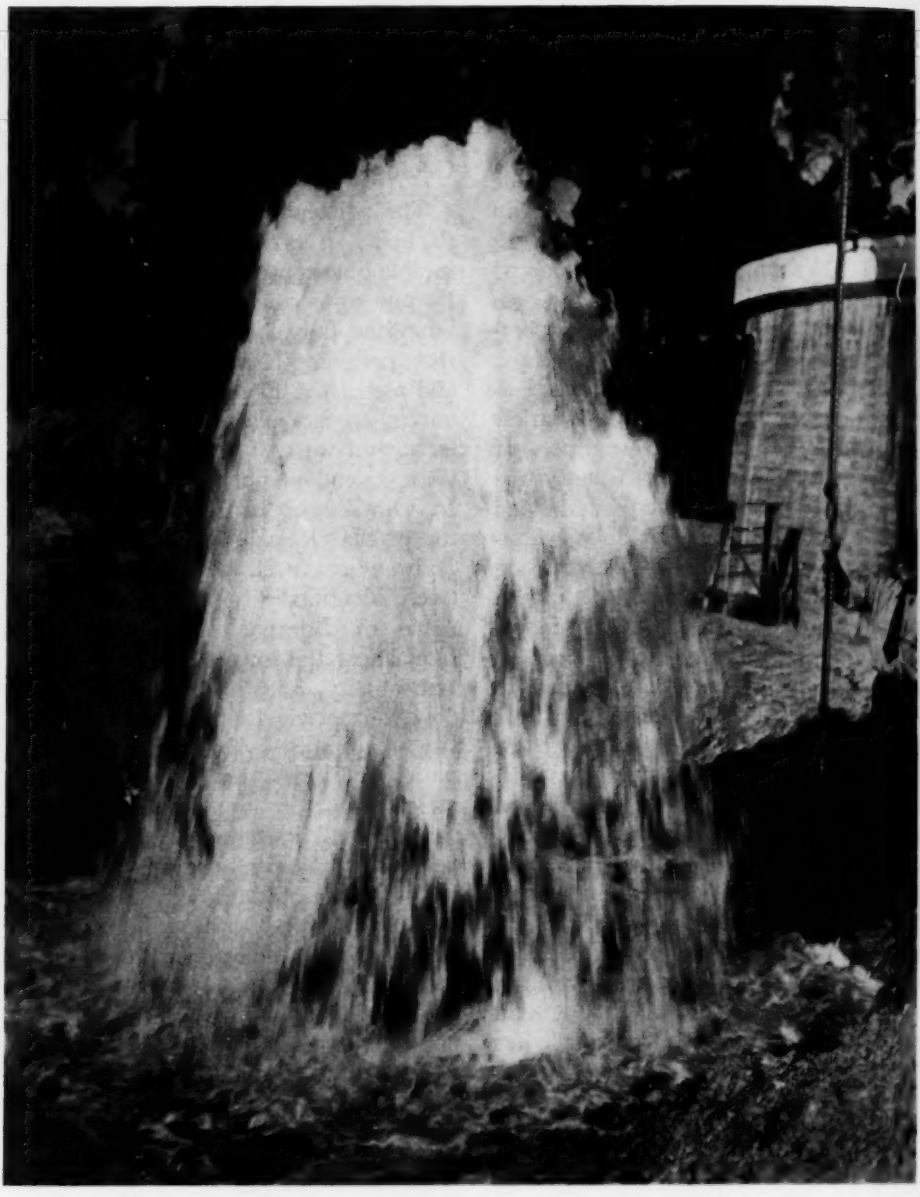


FIG. 1-a. Well Flowing 6,500 Gpm. Near Yukon, Duval County, Fla.

mation form an effective confining bed over most of the area, retarding upward flow of artesian water from the aquifer or downward flow from the surface. Pleistocene and recent formations, consisting chiefly of surface sands and alluvium, overlie the Hawthorn formation at most places. The

FIG. 1-b. Well Supplying a Small Lake, South Jacksonville, Fla.

Hawthorn and younger formations yield small quantities of artesian and non-artesian water. Because this water is generally softer than that obtained from the Eocene limestones, and because it may be obtained from relatively shallow depths, it is used by many domestic consumers and a few laundries. The quantity of water that may be obtained from these formations is so small, however, that all large developments obtain water from the underlying Eocene limestones.

Wells

Wells that penetrate the aquifer range in diameter from 2 in. to 24 in. and in depth from 200 to 1,300 ft. In an area about 25 mi. wide, bordering the coast, the water level in these wells will rise above the land surface, except in a few small areas where the land surface is relatively high. Some of the wells will yield, by natural flow, as much as several thousand gallons a minute. A 12-in. well drilled by Stevens Southern Company near Yukon, Duval County, in November 1942, flowed 6,500 gpm. when first completed (Fig. 1-a, 1-b). The initial flows from

two other wells near Yukon, measured by the writer, were 3,200 and 4,100 gallons a minute. A well 1,440 ft. deep at St. Augustine is reported (4) to have yielded 6,075 gpm. by natural flow when it had been drilled to a depth of 1,110 ft., but water from this well is much too highly mineralized to be satisfactory for human consumption.

Properly constructed wells are tightly cased from the land surface to the top of the aquifer. Many wells do not have sufficient casing, and these allow artesian water from the aquifer to leak upward into the Hawthorn formation, causing a lowering of the artesian pressure and depletion of the water available for consumption.

Quality of Water

The total hardness of the water from the aquifer ranges between 250 and 350 ppm. in most parts of Duval and Nassau Counties but is less than 100 ppm. at places 15 mi. or more southwest from Jacksonville. Bicarbonate ranges between 140 and 195 ppm., and sulfate between 60 and 180 ppm. Chloride is less than 35 ppm. except in a small area on Fort George Island, 14 mi. northeast from Jacksonville, where it is 90 ppm. in one well and 50 ppm. in another. The water is least mineralized in an area near the northwest corner of Putnam County where the aquifer is being recharged. Relatively highly mineralized water is present at moderate depths 35 mi. southeast from Jacksonville in St. Johns County.

Piezometric Surface

The height to which water would rise with reference to mean sea level in tightly cased wells that penetrate the aquifer in Florida and part of Georgia, 1942, is represented by the contour lines in Fig. 2. The imaginary surface represented by these contour lines is referred to as the piezometric surface of the artesian water. In order to map this surface, accurate measurements of static water levels, in feet above or below selected reference points, were made on a large number of wells throughout the area. The altitudes of the reference points were then determined, and the water-level measurements were added or subtracted to obtain the height to which the water level rose above mean sea level in each well. These heights were used as controls to plot the piezometric surface. Care was taken to use only static pressures that were representative of pressures in the artesian aquifer; pressures in defective wells, when recognized as such, were not used to determine the piezometric surface.

Water in the mains and pipes of a water supply system flows in the direction of the hydraulic gradient, regardless of the inclination of the mains and pipes. In much the same way water in the artesian aquifer flows away from points where the piezometric surface is high toward points where it is low, regardless of the dip of the aquifer. Thus an accurate map of the piezometric surface in a region determines the general horizontal direction of flow of the artesian water at all points, this direction being normal to the contour lines. Where the contour lines enclose an area of high water levels the flow on all sides is directed away from the area. Manifestly, the artesian aquifer is being replenished with water in such an area. Conversely, where contour lines enclose areas of low pressure, water on all sides is flowing into the area, and water is being discharged from the artesian aquifer. Areas in which the aquifer is recharged may be

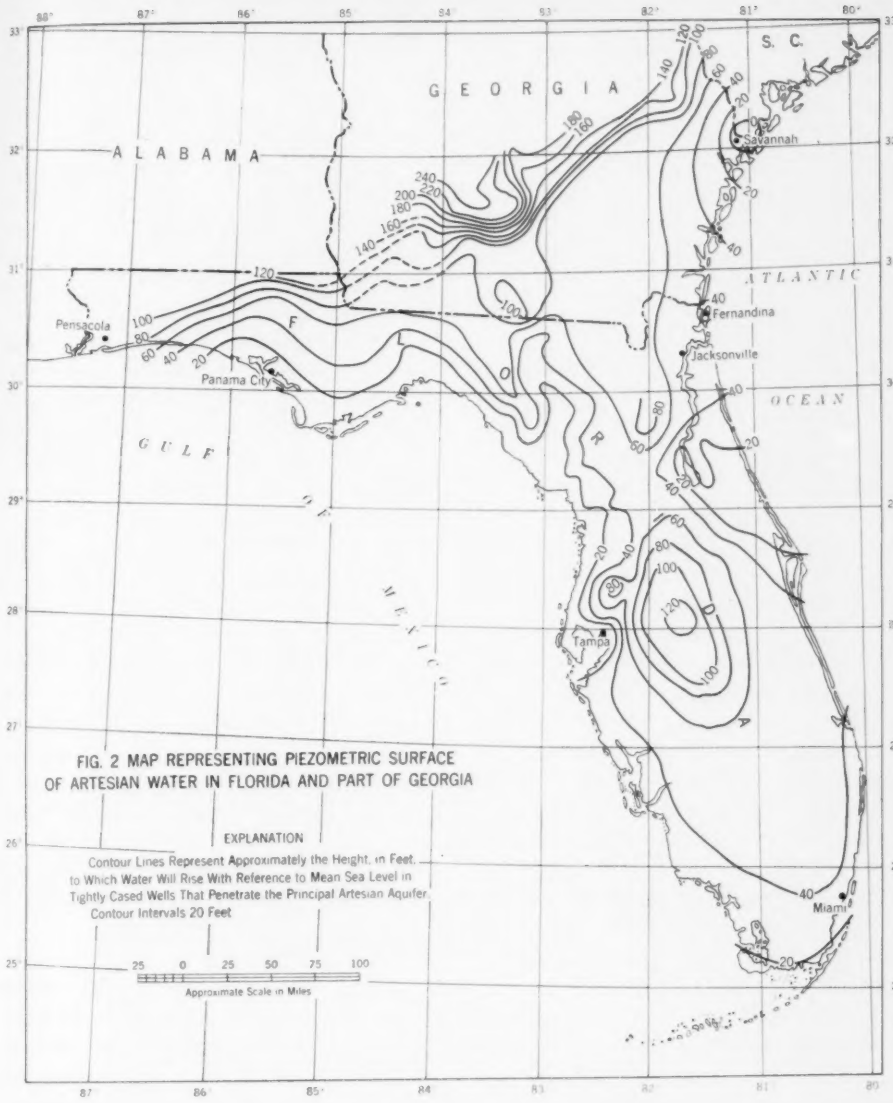


FIG. 2 MAP REPRESENTING PIEZOMETRIC SURFACE OF ARTESIAN WATER IN FLORIDA AND PART OF GEORGIA

referred to as areas of recharge, or intake areas, and those in which it is depleted, as areas of discharge.

Areas of Recharge

Where an artesian aquifer crops out at the surface, rain, surface streams, and lakes may contribute water directly to it. Where it is overlain by permeable material such as sand, rain water falling directly on the material, or water from surface streams or lakes may percolate through that material into the aquifer. If the aquifer is overlain by impervious material, such as that formed by the Hawthorn formation, it may be recharged through sink holes or pockets of permeable material

that extend through the impervious material. Recharge through such sink holes or pockets in the Polk County area in central Florida, where the aquifer is overlain at most places by at least 150 ft. of impervious Hawthorn formation, was recognized by Stringfield (2).

The quantity of water that will enter the aquifer is governed by (1) the net rate at which water is supplied to the recharge area by precipitation and surface streams, and by other bodies of ground water, minus the rate of evaporation and transpiration, (2) the rate at which water may percolate downward to the aquifer through overlying formations, and (3) the rate at which the water may be transmitted laterally through the aquifer away from the points of recharge. If (1) exceeds (2) or (3), water may be stored at the recharge area, providing the area has a capacity for storing water above or below the surface of the ground. The amount of water that may be stored in areas in which artesian aquifers are recharged is especially important because artesian aquifers have very small capacities for storing additional water, and during droughts they must continue to receive enough recharge to balance natural discharge and withdrawal.

The potential rate of recharge, the quantity of water offered to the aquifer, is determined by (1) and (2). If the potential rate exceeds (3), the aquifer will become full of water, and some of the potential recharge will be rejected. The rejected recharge will then become a part of surface runoff, be consumed by transpiration or evaporation, or join another body of ground water. Under these conditions, part or all of the water that would otherwise be rejected can be made to enter the aquifer if the use of wells increases the gradient, and hence the rate of flow, from the recharge area. On the other hand, if there is no rejected recharge under natural conditions, increasing the gradient in the aquifer by the use of wells cannot increase the rate of recharge. The conditions under which rejected recharge may be utilized have been discussed by Meinzer (15) and Theis (16).

Three recharge areas in Georgia and Florida probably supply most of the water being withdrawn in Duval and Nassau Counties. These areas are indicated by high places in the piezometric surface. In Florida the piezometric surface is high near the northwest corner of Putnam County where the aquifer is being recharged through sink holes or pockets of relatively pervious material that extend through the impervious Hawthorn formation. In Georgia, one high place in the piezometric surface is centered around Lowndes County, indicating recharge in that area, and another extends diagonally across southern Georgia where the Hawthorn formation is thin or entirely absent and where water may enter the aquifer readily.

Areas of Discharge

Water is discharged naturally from the artesian aquifer through springs at the surface of the ground and in stream channels, through submarine springs into the Atlantic Ocean or Gulf of Mexico, and by seepage into other ground-water bodies.

Silver Springs, Rainbow Springs, and many other springs, large and small, throughout central, north-central, and west Florida, are examples of discharge from the artesian aquifer. These springs are generally prevalent where the aquifer is at or near the

surface, and where they discharge large quantities of water the piezometric surface is low. In Marion County alone, surface springs discharge several times the quantity of water required by the present population and industries of Florida. This large discharge has created a valley in the piezometric surface between the high areas of the piezometric surface to the north and south. Although the Marion County area is essentially one of discharge, the aquifer there also receives a large amount of recharge.

Many springs are present along the banks of the Suwanee River, and the flow of these springs, and probably that of springs in the channel of the river, has caused the piezometric surface to slope toward the river from both sides.

In the vicinity of Green Cove Springs, in Clay County, Fla., a circular depression is formed in the piezometric surface. The draft from wells in the area is much too small to cause this depression, and the flow from Green Cove Springs is not large enough to cause it. Stringfield (2) has suggested that the depression might be caused by subsurface leakage from the aquifer into the overlying Hawthorn formation through improperly cased wells. Available records indicate that many of the wells in this area are not cased entirely through the Hawthorn formation, and through such wells water may leak upward from the high pressures in the aquifer. The writer believes, however, that most of the subsurface leakage in this area is natural, and not through defective wells. Published and unpublished chemical analyses by the Federal Geological Survey show that water from Green Cove Springs is very similar to that from wells that yield water from the aquifer near the spring. Moreover, as mentioned by Stringfield, changes in the flow of Green Cove Springs influence the water level in at least one of these wells. It is therefore suggested here that the aquifer is the source of Green Cove Springs and that the flow of the Spring is only a small part of the water that is leaking from the aquifer into the Hawthorn formation. Some of the water leaking from the aquifer joins other bodies of ground water, and some of it probably flows into the St. Johns River.

Water is being discharged from the aquifer into the Atlantic Ocean and the Gulf of Mexico at many places along the coasts of Florida and Georgia. In northeast Florida the movement of water in the aquifer is, in general, toward an area off the coast of Volusia County, where the top of the aquifer is relatively high, and where the water may more readily find passages through the relatively impervious Hawthorn formation. Artesian water is being discharged through a submarine spring 2½ mi. east of Crescent Beach. The location of this spring and its depth below the surface of the ocean have been charted (2, 17).

Storage and Transmissibility

Every aquifer has a capacity to store water when there is a rise in water level and a capacity to transmit water under a hydraulic gradient. In considering these capacities Meinzer (15) has compared permeable rock formations to conduits and reservoirs.

Water levels in an artesian aquifer decline rapidly after the rate of withdrawal from wells is increased. Water levels in a non-artesian aquifer decline more slowly. The rate of decline is inversely proportional to the capacity of the aquifer to release water from

storage as the water level declines. A measure of this capacity is "the coefficient of storage," (16) which is the number of cubic feet of water released from storage in a vertical column of the aquifer one foot square when the water level declines one foot. In a non-artesian aquifer water is partly drained from pores and interstices when the water level is lowered, and the coefficient of storage is comparatively large. In an artesian aquifer all pores and interstices remain saturated with water, and the aquifer can release water only by contracting in proportion to its volumetric elasticity when the artesian pressure is decreased. The coefficient of storage of a non-artesian aquifer might be about 0.25, whereas the coefficient for the artesian aquifer at Fernandina, as tentatively determined by pumping tests, is only about .00025. Other pumping tests have indicated coefficients of storage of .017 at Jacksonville and .021 at a place six miles southwest from Whitehouse, in Duval County, but these are much larger than the coefficients usually determined for artesian aquifers. Further tests and studies may reveal the reason for these unusually large coefficients.

A measure of the capacity of an aquifer to transmit water is the "coefficient of transmissibility," (18) which is the number of gallons of water that will be transmitted each day through a vertical cross-section of the aquifer one mile wide under a hydraulic gradient of one foot to a mile. Pumping tests were made at eight places in Duval and Nassau Counties to determine the coefficient of transmissibility of the aquifer.

The aquifer in Duval and Nassau Counties is composed of layers of permeable limestone partly sealed from one another locally by layers of relatively impervious limestone. A well that penetrates only the upper permeable layers will receive little or no water directly from the lower ones. Thus, a coefficient of transmissibility computed from the results of a test on a well that penetrates only a portion of the aquifer generally will not represent the coefficient of transmissibility of the total thickness of the aquifer, but it will represent, approximately, the aggregate coefficient of those permeable layers that supply water directly to the well. In the vicinity of Jacksonville the computed coefficients of transmissibility ranged from about 50,000 to as much as 1,000,000. The smallest coefficient was obtained from a test on a well that penetrates only 250 ft. into the aquifer, and the largest from a test on a well that penetrates 700 ft. A coefficient of transmissibility as large as 1,000,000 is unusual and indicates the presence of caverns in the aquifer, at least in the vicinity of Jacksonville. Drillers report that open caverns are penetrated by some of the wells. During the deepening of Jacksonville municipal well No. 22 at the McDuff pumping station, the artesian flow was reported to have increased almost instantaneously from about 500 to more than 1,500 gpm. when the well penetrated a cavern two feet high at a depth of 1,260 ft. Such caverns can cause a very large coefficient of transmissibility.

At Fernandina, Nassau County, a test for the coefficient of transmissibility was made on a well that penetrates 555 ft. into the aquifer. The coefficient of transmissibility of that thickness of the aquifer is about 150,000. However, the total thickness of the aquifer may have a coefficient of transmissibility larger than that determined by the pumping test.

Cones of Depression

Previous to the development of any wells in an aquifer the ground water is in a state of equilibrium, that is, the amount of water being discharged naturally from the aquifer is equal to the amount entering it at the recharge areas, except for temporary differences due to changes in the amount of water in storage. New discharge from wells is balanced by a decrease in the amount of water stored in the aquifer, a decrease in other discharge, an increase in recharge, or a combination of these changes. In the first instant after a well begins to draw water, all of the withdrawal comes from water stored in the well and in the aquifer immediately adjacent to it. The removal of water from storage lowers the water level and creates a hydraulic gradient toward the well. The shape of the piezometric surface in an area where a hydraulic gradient has formed toward a well or group of wells is referred to as a "cone of depression." As withdrawal continues, water is removed from parts of the aquifer farther from the well, and the cone of depression is extended until it ultimately reaches an area of recharge or one of discharge. When it reaches an area of recharge, the rate of recharge will be increased if there was any rejected recharge previous to the well development. When it reaches an area of other discharge, the rate of that discharge will be decreased. Increase in recharge and decrease in natural discharge may be regarded as salvage. Until the rate of salvage equals the rate of withdrawal from wells, water will be removed from storage and the water levels will continue to decline. Other conditions being equal, the time required for water levels to reach equilibrium is more or less proportional to the coefficient of storage of the aquifer. Obviously, equilibrium will never be established if the rate of withdrawal exceeds the maximum possible rate of salvage.

After equilibrium has been established, the extent and shape of a cone of depression will be governed in part by the coefficient of transmissibility of the aquifer and by the location of areas of withdrawal with respect to areas of recharge and discharge. If the aquifer has a large coefficient of transmissibility, the hydraulic gradient will be comparatively gentle, and the lowering of water levels will be comparatively slight. Also, the lowering of water levels will be comparatively slight if the wells are located near areas of recharge and discharge. With any well development there is a practical limit to the drawdown. At some places the limit may be the bottom of the aquifer; at places near a seacoast it may be the limit beyond which salt water would be drawn into the wells; but probably for most developments the practical limit is an economical one beyond which pumping of water would be too costly. In order to keep drawdowns at a minimum wells must be spaced as far as practicable from one another, and they must be placed as close to areas of recharge or discharge as is feasible. If an aquifer is composed of several more or less continuous layers of hard and soft material occurring alternately, a larger quantity of water for the same drawdown may be obtained by drilling wells through more of the permeable layers and, in effect, increasing the amount of transmissibility of the aquifer available to the wells.

Fig. 3 indicates that previous to any well developments the flow of artesian water in the coastal area of Georgia

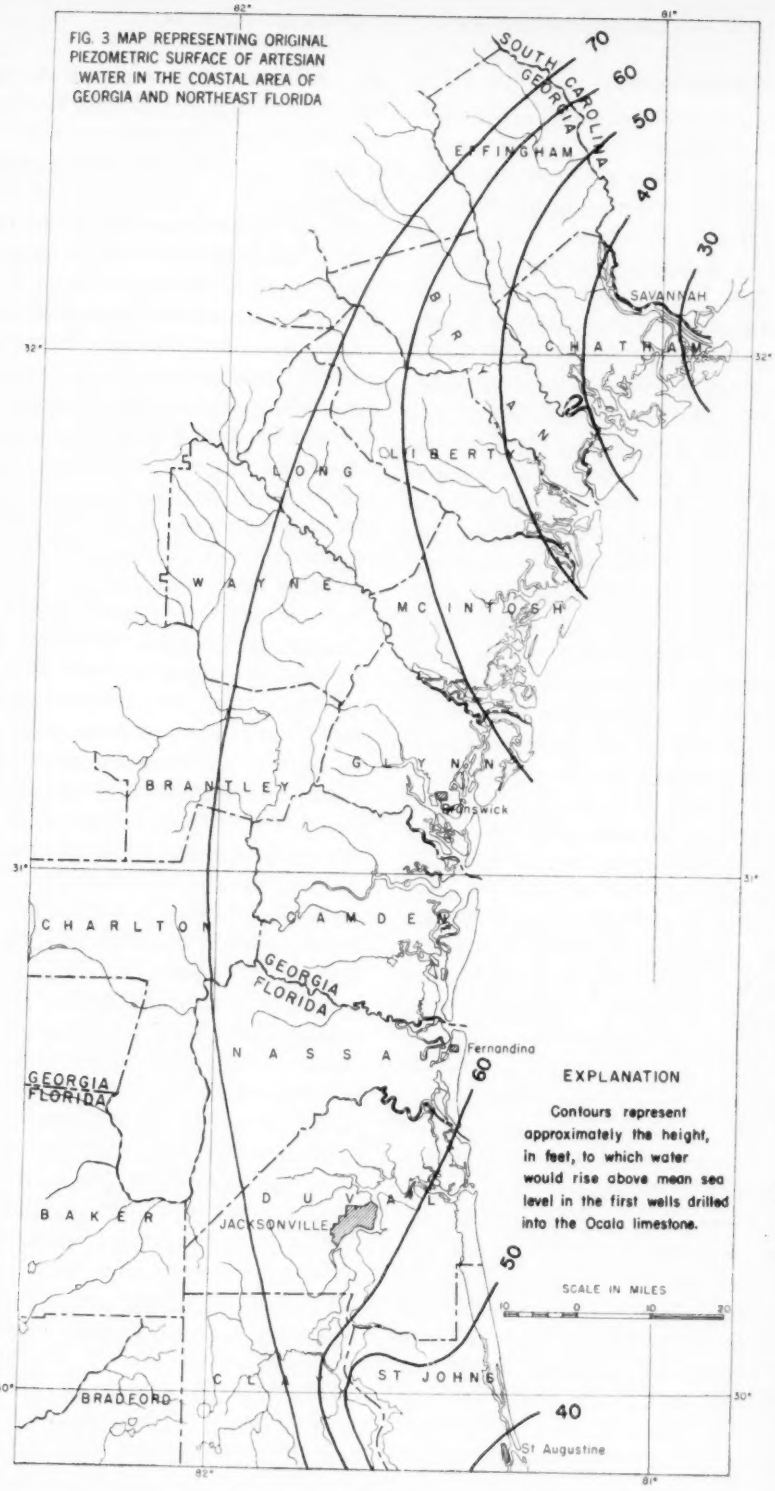


FIG. 3 MAP REPRESENTING ORIGINAL PIEZOMETRIC SURFACE OF ARTESIAN WATER IN THE COASTAL AREA OF GEORGIA AND NORTHEAST FLORIDA

and northeast Florida was toward areas of discharge offshore from Chatham County, George, and Volusia County,* Florida. The withdrawal of water from the aquifer in Duval and Nassau Counties began about 1885, and by the end of 1939 it had increased to about 50 mil.gal. a day, of which 35 mil.gal. was being drawn from wells in the immediate vicinity of Jacksonville. As a result of this withdrawal, a cone of depression had formed around Jacksonville, the water level at the apex of this cone having declined 30 ft. below its original level. In December 1939, a large pulp mill at Fernandina began pumping 26 mil.gal. a day from the aquifer and by the end of 1940 it had increased its pumpage to 30 mil. gal. a day. This pumpage created another large cone of depression around Fernandina. The piezometric surface in 1940, including the cones of depression at Jacksonville and Fernandina, is represented in Fig. 4. A map representing the piezometric surface at Jacksonville was included in an unpublished report by Pirnie (6) in 1927.

Wells drilled in Duval and Nassau Counties penetrate alternate layers of hard and soft limestone ranging from a few feet to more than a hundred feet in thickness. The hard layers are considerably less permeable than the soft ones, and locally the permeable layers are partly sealed from one another. Thus, a well penetrating only the upper part of the aquifer will receive little or no water directly from the lower part. Near the apex of the Jacksonville cone of depression heavy withdrawal from wells penetrating only the upper part of the aquifer has caused the artesian pressure in the upper part to be considerably less than in the lower part. Few wells penetrate the lower part. The cone of depression in the immediate vicinity of Jacksonville was mapped generally from pressures in wells less than 1,050 ft. deep. It is significant that the City of Jacksonville well No. 7 at the intersection of Hubbard and Confederate Streets, which is 1,250 ft. deep and situated at the apex of the cone of depression, had a head of 55 ft. above mean sea level in 1940, whereas the shallower wells used to map the cone of depression there had heads of less than 40 ft. Presumably the well 1,250 ft. deep was cased only to the top of the Ocala limestone, as are other wells in the vicinity, so that the pressure in the well was a composite of pressures in all parts of the aquifer from the top of the Ocala limestone to the level 1,250 ft. below the surface. If the well had been cased to 1,250 ft., the pressure in it would have been more than 55 ft. above mean sea level—possibly as much as 60 ft.

* Approximately 50 mi. south of St. Augustine.

Water-Level Records

Probably no information is of greater value for a quantitative study of ground water than a record of the past performances of water levels under the influence of withdrawal and precipitation. Such records indicate to what extent the water stored in an aquifer, or in recharge areas, is being replenished or depleted. To be of maximum value, they must extend over many years and include droughts as well as periods of copious rainfall.

Water-level records in their relation to withdrawal are especially significant. Continued decline of water levels with little or no increase in withdrawal may mean only that equilibrium is not yet established, but if the rate of decline has not diminished long after the with-

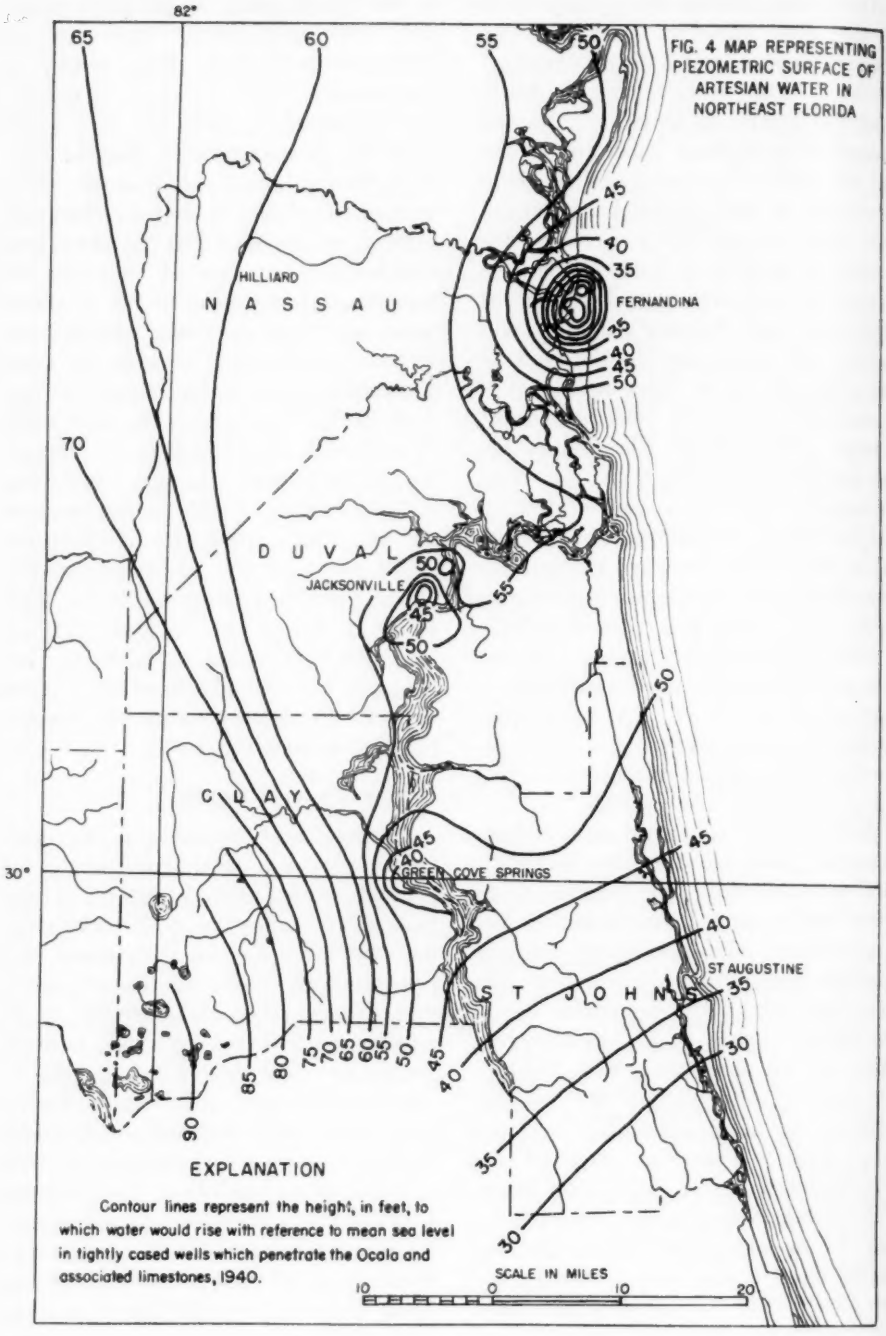


FIG. 4 MAP REPRESENTING PIEZOMETRIC SURFACE OF ARTESIAN WATER IN NORTHEAST FLORIDA

drawal has become constant, and if the precipitation is normal or above normal, it may mean that the perennial yield has been exceeded. On the other hand, if the withdrawal from an aquifer has lowered the water level only slightly, and if there is no further decline with normal precipitation, it is possible that a much larger quantity of water may be safely withdrawn.

Influences other than those of withdrawal and precipitation may act upon water levels. Under certain conditions, the rise and fall of ocean tides, changes in atmospheric pressure, earthquakes at remote parts of the earth, and the passage of railroad trains may all cause water levels to fluctuate. Tidal and barometric fluctuations must be evaluated insofar as possible so that adjustments may be made for them when water-level records are to be studied in conjunction with withdrawal or precipitation.

Measurements of water levels in wells are being made in several parts of Florida. Some wells are visited only a few times a year; some, weekly or daily; and others are equipped with automatic recording instruments that provide continuous, unbroken records of the water levels at any time during a day, month, or year. Four wells in Duval County are equipped with recorders, and water levels in 26 wells in Clay, Duval, Nassau, and St. Johns Counties are measured several times a year. The records on some of these wells extend back as far as 1930.

Salt-Water Encroachment

Records of deep wells which have been drilled in Florida indicate that the entire peninsula is probably underlain with formations containing highly mineralized water. An oil test well, St. Mary's River Oil Corporation, Hilliard Turpentine Company No. 1 well, drilled about seven miles north from Hilliard, Nassau County, penetrated water with almost twice the salinity of sea water from 2,205 to 2,230 ft. below the surface, according to an analysis by the City of Jacksonville on a sample of water taken from the well by Malcolm Pirnie. An analysis supplied to the Florida Geological Survey by Robert B. Campbell indicates that water from a depth of 4,500 ft. in that well was about three times as saline as sea water. At Jacksonville, because of the danger that deep wells might allow salt water from underlying formations to move up and contaminate the aquifer, the lower part of the aquifer has not been developed extensively. As it will be economically advantageous to obtain additional quantities of water that may be needed by deepening existing wells instead of drilling new ones, the lower parts of the aquifer should rightfully be developed if there is ample evidence that moderate deepening of wells will not allow the supply of water to become contaminated with salt water. Recent developments and studies indicate that the aquifer is probably sealed off from any salt water in underlying formations by layers of impervious material. This is confirmed by the fact that relatively high pressures occur in the lower part of the aquifer at the very apex of the cone of depression at Jacksonville, and the fact that the salinity of artesian water in the vicinity of Fernandina has not increased detectably, although heavy pumping in that area has maintained water levels below sea level for three years. Further investigation in the form of test drilling may justify developing the lower part of the aquifer, but such development should be begun only after careful hy-

drologic studies have been made, and it should proceed slowly with competent supervision and with observation of changes in artesian pressures in and below the parts of the aquifer that are developed.

Saline water may move laterally through the aquifer into a well field if the cone of depression extends to where water in the aquifer is saline, or to where sea water may enter the aquifer. Such encroachment probably will not occur in Duval and Nassau Counties unless extremely large cones are created. Water in the aquifer is saline in an area 30 to 35 mi. southeast from Jacksonville, but this water cannot move into the well fields at Jacksonville and Fernandina unless the present cones are greatly expanded. It is possible that a submarine spring, such as the one 2½ mi. offshore from Crescent Beach, may be encompassed by an expanding cone, and its flow reversed so that it will admit sea water into the aquifer; but probably no such spring exists anywhere within range of cones in Duval and Nassau Counties, because the impervious Hawthorn formation, which effectively confines water under artesian pressure throughout both counties, presumably retains its continuity for an ample distance offshore.

Summary

Rapid development of ground water in Florida has increased the need for adequate information on ground-water availability and conservation. Such information is vital especially where overdraft can cause salt-water encroachment. This paper gives some of the information obtained in recent ground-water investigations and brief descriptions of principal concepts and methods used in these investigations.

In Duval and Nassau Counties the principal aquifer consists of a thickness of 800 ft. or more of permeable limestone, the top of which lies 250 to 550 ft. below the surface. In tightly cased wells penetrating the aquifer water will rise above the surface at most places. Some of these wells will yield about 5,000 gpm. by natural flow. The total hardness of the water in the aquifer is generally between 250 and 350 ppm. but is less than 100 ppm. at places 15 mi. and more southwest from Jacksonville. Tests for the coefficient of transmissibility of the aquifer have been made at eight places in Duval and Nassau Counties on wells penetrating from 250 to 850 ft. into the aquifer. At Jacksonville a coefficient of 1,000,000, the highest one determined, was computed from the results of a test on a well that penetrates 700 ft. into the aquifer, and a coefficient of 50,000, the lowest, from a test on a well that penetrates 250 ft. into the aquifer. At Fernadina a coefficient of 150,000 was computed from a test on a well penetrating 550 ft. into the aquifer. The aquifer is recharged with water at several places in Georgia and Florida.

The withdrawal of 35 mil.gal. of water a day from artesian wells at Jacksonville and 35 mil.gal. at Fernandina has created two large cones of depression in the piezometric surface of the artesian water. The apex of the cone at Jacksonville is about 35 ft. above sea level and about 30 ft. below the original piezometric surface. The apex of the cone at Fernandina is more than 20 ft. below sea level and more than 80 ft. below the original piezometric surface.

At many places in Florida salt water is present at moderate depths, and at other places it may move into a well

field laterally if the cone of depression extends to a place where salt water is present in the aquifer or may enter it. Where there is danger of salt-water encroachment, the lowering of water levels, which inevitably accompanies any withdrawal, should be maintained at a minimum. Investigations in Duval and Nassau Counties have disclosed no evidence of salt-water encroachment, but development of lower parts of the aquifer at Jacksonville may admit salt water from underlying formations unless such development is planned carefully on the basis of information obtained from test drilling.

References

1. Stringfield, V. T., Warren, M. A. & Cooper, H. H. Jr. Artesian Water in the Coastal Area of Georgia and Northeastern Florida. Econ. Geol., **36**: 698 (1941).
2. Stringfield, V. T. Artesian Water in the Florida Peninsula. U.S. Geol. Survey Water-Supply Paper 773-C (1936); Ground-Water Supplies in Florida. Civ. Eng. **8**: 458 (1938).
3. Sellards, E. H. A Preliminary Report on the Underground Water Supply of Central Florida. Florida Geol. Survey Bul. 1 (1908).
4. Sellards, E. H., & Gunter, Herman. The Artesian Water Supply of Eastern Florida. Florida Geol. Survey 3d Ann. Rept., (1910); pp. 77–195; The Underground Water Supply of West-Central and West Florida. Florida Geol. Survey 4th Ann. Rept., (1912); pp. 81–155; The Artesian Water Supply of Eastern and Southern Florida. Florida Geol. Survey 5th Ann. Rept., (1913); pp. 103–290.
5. Matson, G. C. & Sanford, Samuel. Geology and Ground Waters of Florida. U.S. Geol. Survey Water-Supply Paper 319 (1913).
6. Pirnie, Malcolm. *Investigations to Determine the Source and Sufficiency of the Supply of Water in the Ocala Limestone as a Municipal Supply for Jacksonville.* Hazen & Whipple, New York (1927).
7. Collins, W. D. & Howard, C. S. Chemical Character of the Water of Florida. U.S. Geol. Survey Water-Supply Paper 596-G, (1928); pp. 177–233.
8. Gunter, Herman & Ponton, G. M. Need for Conservation and Protection of Our Water Supply With Special Reference to Waters From the Ocala Limestone. Florida Geol. Survey 22d Ann. Rept., (1931); pp. 43–55.
9. Stubbs, S. A. A Study of the Artesian Water Supply of Seminole County, Florida. Proc. Florida Academy of Sciences, Vol. II, (1937); p. 24.
10. Stringfield, V. T. Ground-Water Investigations in Florida. Florida Geol. Survey Bul. 11 (1935); Ground-Water Resources of Sarasota County, Florida Geol. Survey 23d–24th Ann. Rept. (1933); pp. 121–194; Ground Water in Seminole County, Florida. Florida State Board Conservation, Geol. Dept., Rept. 1 (1934); Ground Water in the Lake Okeechobee Area, Florida. Florida State Board Conservation Geol. Dept. Rept. 2 (1933).
11. Cross, W. P., Love, S. K., Parker, G. G., & Wallace, D. S. Water Resources of Southeastern Florida. Mimeographed report and memorandum for the press (Mar. 29, 1941).
12. Cross, W. P. & Love, S. K. Ground Water in Southeastern Florida. Jour. A.W.W.A., **34**: 490 (1942).
13. Parker, G. G. Notes on the Geology and Ground Water in the Everglades in Southern Florida. Proc. Soil Science Society of Florida, Vol. IV–A, (1942); pp. 47–76.
14. Campbell, Robert B. Outline of the Geological History of Peninsular Florida. Proc. Florida Academy of Sciences, Vol. IV, (1939); p. 91.
15. Meinzer, O. E. Outline of Methods for Estimating Ground-Water Supplies. U.S. Geol. Survey Water-Supply Paper 638 (1931).
16. Theis, C. V. The Source of Water Derived From Wells. Civ. Eng., **10**: 277 (1940).
17. Florida Inside Route, St. Augustine to Titusville. U.S. Coast & Geodetic Survey Chart 3258 (1931).
18. Theis, C. V. The Relation Between the Lowering of the Piezometric Surface and the Rate and Duration of Discharge of a Well Using Ground-Water Storage. Am. Geophy. Union Trans., (1935); p. 519.

Emergency Chlorination Program in Los Angeles County

By C. W. Sopp

BROKEN water mains, especially those in close proximity to sewer lines, are a dangerous source of pollution of domestic water supply. Such pollution may cause widespread illness, absenteeism in war industries, added burdens on friends and communities and even death. It may be a more effective enemy agent than explosive bombs and its effect may equal or exceed that of extensive incendiary bombing. On the other hand, large numbers of broken mains and, therefore, pollution may result from enemy bombing as well as from earthquakes and floods.

The Los Angeles County Emergency Chlorination Program was initiated because of the possibility that the West Coast area might be bombed during the war. The program will be equally effective, however, in the event of earthquakes and floods, so it is planned to maintain a skeleton organization even after the danger of enemy bombing is over. Los Angeles County and the whole Pacific Coast area are subject to earthquakes and floods which may disrupt the water service. The San Francisco, Santa Barbara and Long Beach shocks and the floods of 1914, 1916 and 1938 are ready examples of this danger.

Of the approximately 500 water utilities in Los Angeles County many are small and have neither equipment for, nor experience in, the sterilization of water mains. Likewise, they are not experienced in determining the high residuals necessary.

Purpose of the Plan—Personnel

The purpose of the program, therefore, is to supply, on a mutual aid basis, skilled supervision for the inspection of broken mains to determine the necessity for treatment, sterilization chlorine residual tests, and bacterial tests to determine the adequacy of sterilization.

For the purposes of civilian defense the county has adopted the sheriff's subdivisions for subcontrol areas. These have been extended to include municipally incorporated areas. Under this plan there is a civilian defense control center in each of the sheriff's substations and in many of the municipalities. Sparsely inhabited regions, such as mountain and desert areas, are excluded. At each subcontrol center there is a water works officer who is ex officio a chlorination officer.

The personnel consists of a chief chlorination officer and three assistant

A paper presented on October 29, 1943, at the California Section Meeting, Los Angeles, Calif., by C. W. Sopp, Chief Chlorination Officer, Los Angeles County Defense Council, Pasadena, Calif.

chlorination officers * selected from men experienced in the chlorination and sterilization of mains. The county has been broken down into four subdivisions, each comprising a number of subcontrol areas. Each of the chlorination officers has general supervision of main sterilization in one of these subdivisions. To assist the chlorination officers, chlorination supervisors, selected from chlorination equipment manufacturers' representatives and from water works personnel within the subcontrol areas, have been appointed.

Water utility employees were given instruction at seven schools held throughout the county. Instruction was given by means of diagrams, bulletins, standard equipment and gadgets. The purpose was to educate water utility employees to take proper action on their own problems and thus be self-sufficient. From the attendance at these schools it is believed that the effort was well repaid.

Equipment

A canvass was made of all chlorination equipment in the county that might possibly be used in an emergency. Manufacturers' sales records, county health department records and questionnaires sent to many of the utilities were used to conduct this survey. The equipment was classified into three priority lists, the first priority being given to equipment normally in stock at manufacturing and sales firms. The second priority list included portable chlorination equipment owned by the larger water utilities, and the third, non-essential equipment that might be used as a last resort, such as that used for swimming pool chlorination. These lists were combined with general information on the necessity for, and methods of, sterilization of water mains, and notes on liquid chlorine, the available chlorine in hypochlorite powder and stock solutions in bulletin form. The complete bulletin, containing lists of equipment and vendors of chlorine products is on file in the county control center and at the office of the chief chlorination officer. Lists of equipment and material pertaining to each individual subcontrol area, together with general instructions for securing equipment, is on file in each subcontrol center. These lists are in the custody of the water works officer at each center.

Operation

The chlorination officers have general supervision of the selection, training and work of the chlorination supervisors. In the event of bombing, the supervisors report to the water works officer at the control center and learn the location of broken mains. Chlorination officers and supervisors from other areas are to assist in stricken areas if necessary. As an indication of the probable necessity for sterilization due to sewage pollution, the supervisors obtain from the city engineer the location of sewage lines and the chlorination officers have copies of maps showing the sewered areas in unincorporated territory. The standards governing recommendations for sterilization are as follows:

Chlorination probably is not required:

1. Where dirt did not enter the mains.

* Louis J. Alexander, Southern California Water Co., Los Angeles, Calif.; Harry Hayes, Asst. San. Engr., Bureau of Water Works & Supply, Los Angeles; John Perhab, City of Beverly Hills; and C. W. Sopp, Chief Chlorination Officer, Los Angeles County Defense Council, Pasadena, Calif.

2. Where there are no sewers or cesspools within 60 ft. of the break.

3. Where pressure on the mains is not lost or where water was discharged from both ends of the break at the time the main was shut down and there was no drainage into the mains.

Chlorination probably is required:

1. Where broken sewers and water mains exist in the same crater or in close proximity.

2. Where fissures or gopher holes permit sewage from adjoining cesspools to enter the area of the break.

3. Where there is dirt in the mains.

Care must be exercised as the water at a given break might be contaminated by sewage entering the main from a distant break and flowing through the water main into the area being examined.

The supervisors have no authority; they merely make recommendations as to whether or not service may be resumed without sterilization and assist in the selection of the best method of sterilizing the water mains, in obtaining proper equipment, in the application of chlorine, in taking samples and in the subsequent flushing of mains and taps.

High chlorine residuals used in main sterilization are to be determined by use of the Army kit modified to the drop dilution method. Ortho-tolodine is used in tablet form rather than in the customary solution.

Where the utility has the equipment, material and skilled personnel, it is expected that it will do its own sterilization. Where equipment, material and skilled personnel are not available, they will be secured through the water works officer at the control center. For the proper selection of material and equipment needed, the water works officer requires the following information for each situation:

1. Name, address and telephone number of the utility.

2. Name of the person calling.

3. Location of the job for dispatch of equipment.

4. Whether equipment is to be delivered or picked up.

5. Whether liquid chlorine or hypochlorite solution is best adapted for the job.

6. If liquid chlorine is best adapted:

a. Desired capacity or rate of feed.

b. Direct gas or solution feed required.

c. Whether feed is into open water or main against back-pressure.

d. If back-pressure exists, its amount.

e. Voltage and cycle of current available for solution feed pumps.

f. Whether hypochlorite powder or solution is required.

g. Whether skilled personnel is required.

With this information, the water works officer selects the required equipment from the first priority list of vendor's stocks. If the proper equipment is not there obtainable he makes a selection from the second priority list of portable equipment available from adjoining utilities and, similarly, he may select equipment from the third priority list. All requests for equipment are cleared through the control center so that the water works officer may have a record of all equipment in use and thus not available for subsequent jobs. This procedure avoids lost effort and duplication of requests for assistance from the same party. If equipment is not available within the individual subcontrol area requests are made by the water works officer to the adjoining subcontrol center. It is ex-

pected that the utility requesting the emergency service of equipment shall pay the parties supplying the equipment on a time and material basis, the financial arrangements to be made after cessation of the emergency.

From the foregoing outline it is seen that the program is a mutual aid plan. The same basic plan and organization, somewhat modified, should be continued after the present war emergency for action during other disasters, such as earthquakes and floods.

Effect of Approach Piping on the Accuracy of Water Meters

By L. F. Moullet and H. A. Knudsen

IT has always been the policy of the East Bay Municipal Utility District to filter all water supplied in order to maintain an uninterrupted high standard of quality. Consequently, the question of omitting the sedimentation trap, usually installed with large meters, has been considered for some time.

If the sedimentation trap is used only for intercepting foreign substances before they reach the meter, its presence cannot be justified. It has been felt, however, that the arrangement of the approach piping to large meters would have some disturbing effect, in many cases, if the trap were not used. Accordingly, tests were conducted to determine the effect of traps and approach piping on the accuracy of the meters.

Although only one make of meter was used in these investigations, it was not intended to sponsor or to reveal any undesirable features (if they exist) of any meter. It should be taken into account that some manufacturers recommend the use of traps to improve the accuracy of registration.

A paper presented on October 29, 1943, at the California Section Meeting, Los Angeles, Calif., by L. F. Moullet, Mech. Engr., and H. A. Knudsen, Mech. & Elec. Engr., East Bay Municipal Utility District, Oakland, Calif.

All meters tested were of the compound type, including the usual turbine and bypass disc elements and provided with an automatic weighted valve to shut off the turbine meter at low flows.

Two Groups of Tests

Two main groups of experiments were made. The first group comprised a series of tests using a single 4-in. meter with various arrangements of approach piping, followed by a similar, but more extensive, set of tests on a 6-in. meter. The second group of tests was made with a battery of two 4-in. meters using three different piping layouts.

All the test data have been reduced to graphical form and consist principally of percentage registration curves and piping layouts. Wherever possible, an elementary diagram of the approach piping arrangement used in each test series is accompanied by percentage registration curve. These diagrams show the piping in plan or elevation as required and are identified with their corresponding curves by the use of letters. All tests without traps are represented with solid lines, while dotted lines are used for tests with traps.

Observations were confined principally to the substantial flow rates,

since the bypass disc meter, which is not affected by irregularities of approach piping, takes over a larger share of the metering as the flow is diminished. For obvious reasons the inlet gate was kept fully open while the flows were controlled by the outlet gate.

First Test Group Investigations With 4-In. Meter

The first group of tests, conducted with a 4-in. meter and followed by similar tests with a 6-in. meter, was made at the meter shop. In each case the tests were preceded by standard shops tests, with and without the trap.

Figure 1 shows the test curves obtained with the standard shop tests on the 4-in. meter. Similar data for the 6-in. meter will be referred to in turn. The meter or trap is preceded by a straight piece of 4-in. pipe, 63 in. long. For flows in excess of 200 gpm. the percentage registration curves agree within $\frac{1}{2}$ per cent of each other and are close to 100 per cent.

By the use of flanged elbows and nipples assembled in the form of a "U" as indicated in Fig. 2, it was possible to conduct the flow to the meter or trap from the right, left, top and, with some modification, from the bottom. The arrangement shown in Elevation D was resorted to as the center-line of the testing installation piping is only about 19 in. above the floor. The amount of offset in the "U" piping was limited by the proximity of the meter shop wall. This handicapping feature later revealed some interesting results when the 6-in. meter was tested.

Reference to Fig. 2 will give practically a complete compilation of the first series of tests. Three sets of tests were made with the approach piping in a horizontal position as indicated by Plans A, B and E. The two vertical positions of piping are shown by Elevations C and D. Plan E is a duplication of Plan B except that long radius elbows were substituted at the inlet and outlet positions of the "U" and are indicated by "a" and "b." With this one exception, all tests in both groups were made with standard elbows or fittings.

It may be noted that a considerable discrepancy occurred when the trap was omitted and the flow approached horizontally from the right or left as indicated in Plans A and B. The registration ranged from about 95 per cent to nearly 106 per cent. The substitution of the two long radius elbows in Plan E improved the registration of the meter about 2 per cent, in this instance at least, but still gave a percentage registration of 104. Approach from top or bottom (Elevations C and D) had less serious effect as the registrations were about 101 per cent in each case.

When the trap was used, as indicated by the dotted lines, it was found that although all the tests did not completely agree, the results were within about 1.5 per cent of each other in all cases and deviated less than 1 per cent from the standard test with straight-approach pipe noted in Fig. 1.

First Test Group Investigations With 6-In Meter

Upon completion of the tests with the 4-in. meter, similar experiments were made with a 6-in. meter. Fig. 3 shows the results of the standard shop test. This meter registered about 100 per cent at average flows when the trap was included, as compared to 99 per cent when the trap was omitted. Fig. 4 and 5 give the elementary pip-

ing details and accuracy curves of the remaining tests.

Upon completing the tests corresponding to Plans F and G and Elevations H and J (Fig. 4), comparisons were made with the corresponding observations on the 4-in. meter. It was found that the 6-in. meter showed considerably less error than the 4-in. meter referred to in Fig. 2. This was due to the relatively more compact arrangement made necessary in the case of the 6-in. meter by the restricted space between the shop wall on the left and the main center-line of the shop testing installation. As space was available to the right, the two 17½-in. offset nipples were replaced with 61-in. nipples as shown by Plans F and K (Fig. 4). From the corresponding percentage registration curves it will be noted that, due to this change, the registration at full flows decreased from a value of a little over 96 per cent to just above 91 per cent. By placing a 17½-in. nipple between the last elbow and the meter, as indicated in Plan L (Fig. 5), the percentage registration increased to practically 98, an improvement of 6.5 to 7 per cent.

As might be expected, Plans M and N (Fig. 5) gave identical results, the 28-in. nipple following the meter having no effect. The registration, however, was only slightly above 104 per cent. A casual comparison with Plan K in Fig. 4, where approach was from the right, might lead to the belief that, for approach from left, as in Plans M or N, this percentage should have been in the neighborhood of 108 or 109 instead of approximately 104. This discrepancy shows that the 61-in. nipple was not long enough to nullify the effects of fittings preceding it. Although not indicated in the diagrams (Figs. 4–5), there was an irregular approach to the inlet gate valve at the entrance of the "U" arrangement.

Plan P consists of a compact "U" followed by a 28-in. nipple. While this combination gave results closely approaching the standard test with trap, it is not considered as offering a solution, but indicates that the results may be quite unpredictable.

The tests of the 4- and 6-in. meters, covered by Figs. 1 to 5 inclusive, complete the first main group of investigations. Thus far it appears that under some conditions the approach piping may cause considerable error when the trap is not included. It has also been observed that discrepancies are caused not only by a single element of the approach piping but by a combination of several disturbing units such as elbows.

Second Test Group Investigations With Battery

Since the more compact piping assembly used in the case of the 6-in. meter in the first group of tests improved the accuracy of the meter considerably over similar tests on a 4-in. meter with a more expanded approach piping layout, it was thought that the still more compact assembly of standard battery installations might prove satisfactory if the traps were eliminated. Accordingly a second group of tests, comprising three different battery arrangements, was made.

As the space in the meter shop was limited, it was necessary to conduct the second group of tests at one of the filter plants. Two pipe connections, about 20 ft. apart on the same center-line, were available, consisting of a 16-in. gate at one end and a 16×6-in. reducing flange at the other. These connections were in a building in a concreted trench and several feet below the floor—not an ideal setup, but

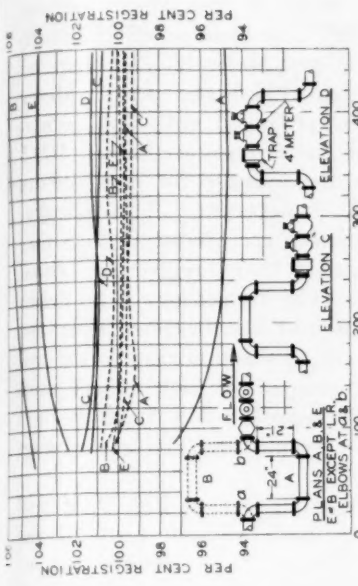


Fig. 2. Tests on 4-In. Meter With Various Arrangements of Approach Piping

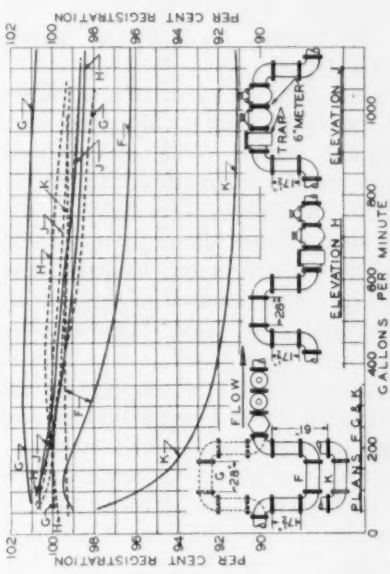


Fig. 4. Tests on 6-In Meter With Various Arrangements of Approach Piping

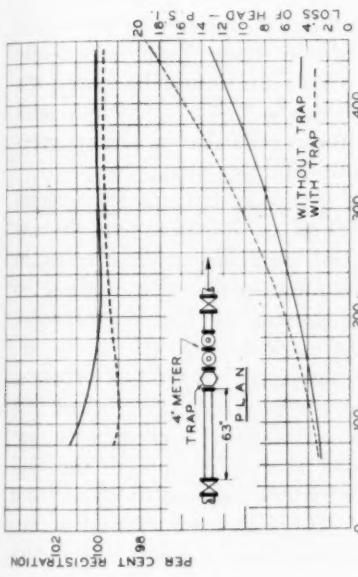


Fig. 1. Standard Shop Tests on 4-In. Meter

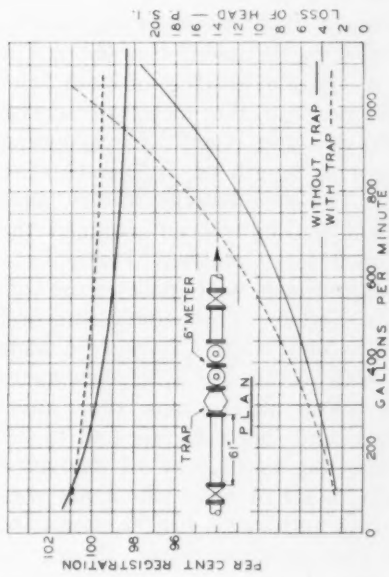


Fig. 3. Standard Shop Tests on 6-In. Meter

satisfactory. As the trench was not wide enough, it was necessary to support the battery on planking placed over the trench.

No test tank was available, so flows were measured with a calibrated 6-in. compound meter. All observations were adjusted as required to correspond to a 100-per cent test in the meter shop. Since the registrations of each of the three meters deviated less than 1 per cent from true flow at all of the flow rates used, however, the adjustments were small.

Figures 6, 7 and 8 show in plan and elevation the three 2-meter battery and piping layouts used. The arrangement with the battery oriented in line with the service pipe (Fig. 6), is the one generally used by the East Bay Municipal Utility District. On a few occasions the meters are installed at right angles to the center-line of the service as indicated in Fig. 7. Figure 8 shows a modification of the battery in Fig. 6 by the addition of nipples A and B and the placing of both inlet valves next to the meters. Several lengths of nipple A with corresponding changes in length of B and C were used. The two battery meters were identical but have been assigned the simplified serial numbers 1 and 2.

The first tests were made of the battery in Fig. 6. The battery was first tested without traps. Tests were made with both meters and with each meter alone. The meters were then interchanged and the tests repeated to determine the consistency of the tests. Finally, a set of tests was made with the traps included. Fig. 9 shows the results of all these tests. It may be seen that the battery registered about 6 per cent fast when traps were omitted and was essentially correct when the traps were included. With its companion meter shut off at inlet and outlet and when it was alone without trap in the right hand or offset branch of the battery, Meter No. 2 registered higher than 111.5 per cent. Meter No. 1, interchanged with and substituted for No. 2, registered about 109.5 per cent, the average for both meters being 110.5 per cent. Theoretically, as the meters are identical, both meters should have registered equal amounts. The discrepancy is no doubt due to the unstable character given the flow by the tees and elbows in the approach piping. The high values were caused by approach flow from the left as may be verified by reference to Fig. 2, Plan B.

Referring further to Fig. 9, it will be found that, for solo tests of the meters, without traps, on the left or straight branch of the battery, No. 2 registered about 101.5 per cent and No. 1, 101 per cent. Some unbalanced disturbance existed; otherwise the registration would have been practically 100 per cent. It should be noted too that all the solo tests for meters with traps, without regard to position, averaged about 99.5 per cent.

As the inclusion of traps gave registrations close to 100 per cent, it was not deemed necessary to use traps in the subsequent tests. Proceeding to the arrangement in Fig 7, reference should be made to Fig. 10 for the results of the tests. With both meters, the battery registered higher than 107 per cent, or about 1 per cent higher than noted in Fig. 9, due to the fact that both meters received the flow from the left. The solo tests showed a considerable discrepancy when the meters were interchanged. Thus, it appears that the disturbance caused by the fittings and piping is very unstable. If each pair of interchange tests is aver-

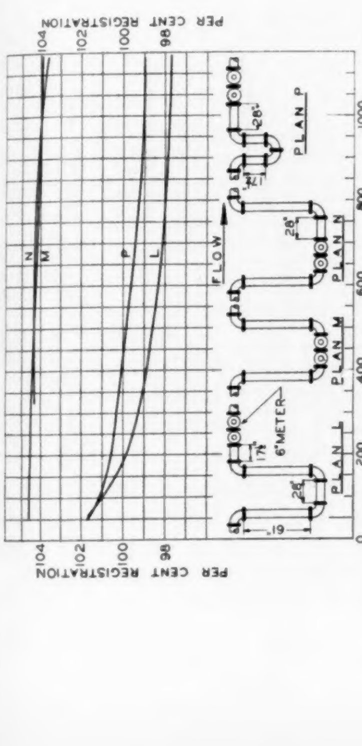


Fig. 5. Additional Tests on 6-In. Meter With Various Arrangements of Approach Piping

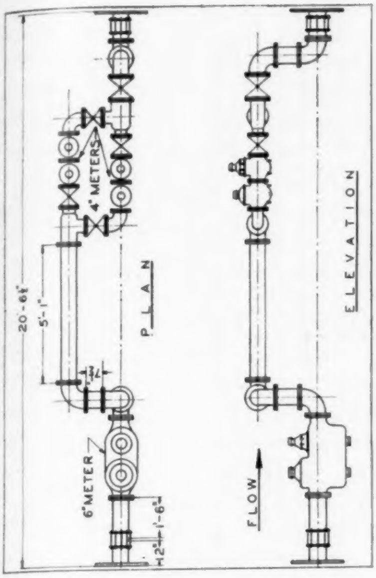


Fig. 6. First Battery Testing Arrangement

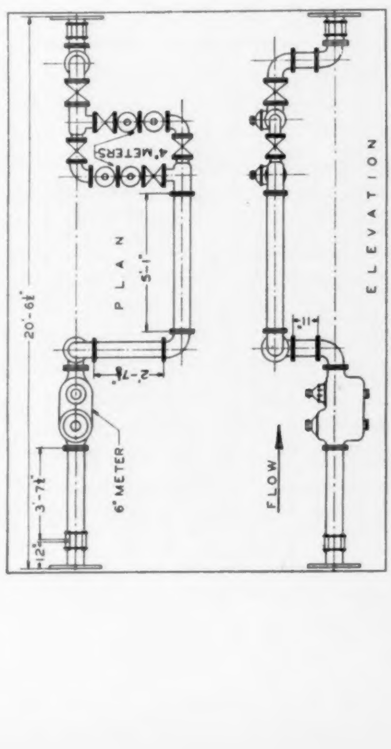


Fig. 7. Second Battery Testing Arrangement

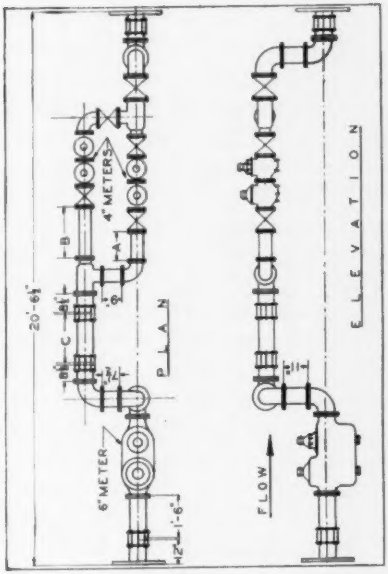


Fig. 8. Third Battery Testing Arrangement

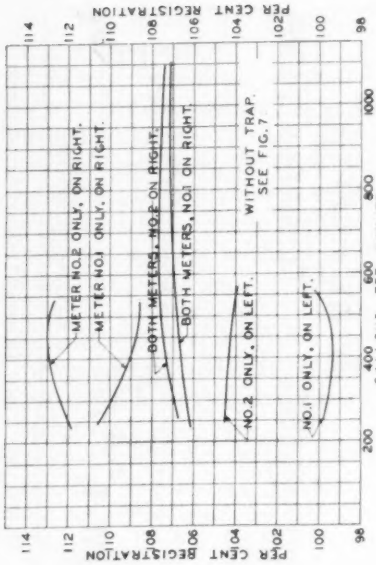


Fig. 10. Tests on Arrangement Shown in Fig. 7

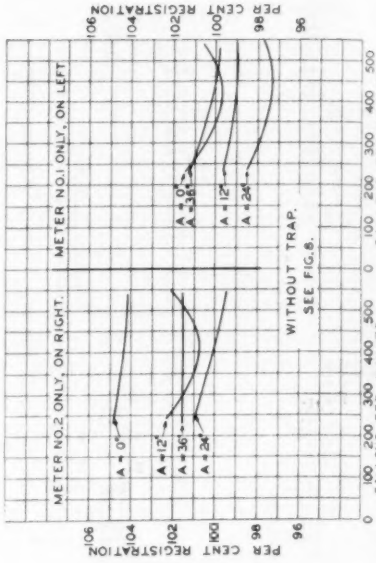


Fig. 12. Tests on Arrangement Shown in Fig. 8, Using Each Meter Alone

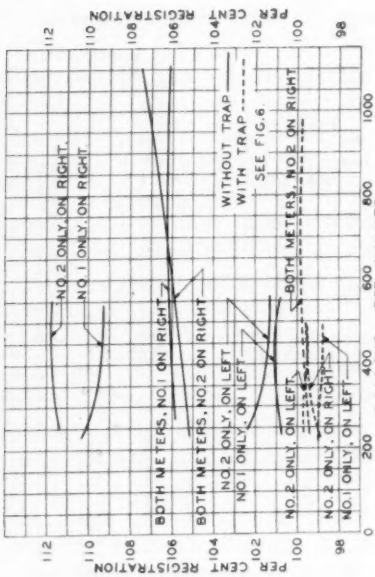


Fig. 9. Tests on Arrangement Shown in Fig. 6

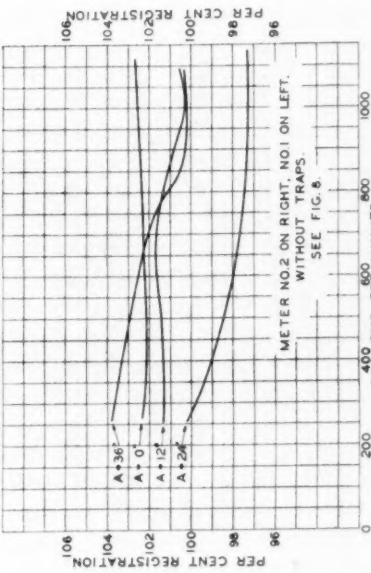


Fig. 11. Tests on Arrangement Shown in Fig. 8, Using Both Meters

aged, however, e.g., at 400 gpm., the following values obtain: 107 per cent for the battery, 111 per cent for the right branch and 101.8 for the left branch. Apparently, then, the reducing tee gives the meter a more favorable approach than the elbow.

Figure 8 illustrates a battery with nipples A and B of various lengths inserted ahead of the gate valves, which, in turn, were bolted to the inlet flanges of the meters. Nipple C was a fill-in piece and was preceded by three elbows. When A was 36 in., C was eliminated and only one "Dresser" coupling joined the two 8½-in. nipples. Fig. 11 shows the erratic nature of the results. The accuracy curves, when A was 36 in. and 24 in., have a marked slope and are approximately parallel with a spread of 3 or 4 per cent between them. Nipple A gives the lowest percentage registration when it is 24 in. long, neither its longest nor shortest dimension. The inconsistency of results in this set of tests was probably due to the fact that, as A is lengthened and C correspondingly shortened, the effect of the three elbows preceding C increased, more than offsetting the ironing out effect of the straight approaches A and B. At any rate there is proof here that replacement of the traps with short nipples would not solve the problem.

Figure 12 is a continuation of Fig. 11, the tests having been repeated with each meter shut off in turn. As was to be expected, the meter on the right registered that higher percentages; otherwise the results are just as erratic as in Fig. 11.

Conclusions

When turbine type meters are used, the arrangement of the approach piping may have considerable effect on the accuracy of registration. Except in a general way, the effect of any particular layout is unpredictable. The accuracy of the meter is influenced not only by the fitting immediately preceding it, but also by other fittings and piping immediately involved.

The introduction of the regular trap at the meter inlet will keep inaccuracies of registration, caused by fittings and piping, within generally accepted limits. Even when traps are used it is best to avoid approach piping layouts which may cause severe flow disturbances whenever practicable. It is to be expected that the trap might, to some degree, lose its effectiveness in correcting inaccurate meter registration if the strainer disappeared as the result of corrosion.

Turbine type meters may be installed without traps if the approach pipe is in line with the meter and straight for some distance. The required length of straight pipe probably varies with the character of the disturbance preceding it. In general, it is believed that this should not be less than 20 pipe diameters. When meters are to be installed without trap they should be tested without trap and with a sufficient length of straight approach pipe.

As turbine meters differ in design, it should not be concluded that all meters of this type would be affected to the same degree by flow approach disturbances.

Experiences of a Lady Water Works Chemist

ORDINARY circumstances caused my induction into the water works field—that is, if you can call a war ordinary. I was just one among many girls called into a man's job because some draft board felt chemists were quite as necessary to the war effort as any one else. Soon after Pearl Harbor, the City of Gastonia found itself without the services of a chemist, and since I was home-town talent and not likely to find myself suddenly in uniform, they felt I was permanent, at least for a while.

My first attitude toward the job was a rather dubious one, since it seemed to me to be entirely out of line with anything I had ever tried, but, having had chemistry in college, I was presumably qualified for the position. So my first analyses were done with "fear and trembling," lest I might be jeopardizing the health of a community of sixty thousand people. It took quite a while for me to gain enough confidence in my laboratory tests, actually, to go out and confront the operators and demand that a machine be set at any certain rate to reach the optimum dosage. Once said I realized that I was up against quite a wall.

As long as I had stayed in my corner with my test tubes and burettes, everything was rosy—I tended to my end of it and the operators ran the plant, which made me equivalent to Mussolini or some such "figure-head" and certainly wasn't earning my salary. But for all that, I could sympathize with the "old hands," for they sincerely felt I knew nothing about it and, being a woman also, was just too much for them to take. It was quite some time before they began to honor my remarks. However, there were a few individuals in the city management who actually outdid themselves to try to make my work easier. Some cooperated to the *nth* degree for which I shall be forever grateful—except for them I am quite sure I would have resigned after the first month.

FIG. 1. My First Analyses Were Done With Fear and Trembling

A paper contributed by Sara K. Philhower, City Chemist, Gastonia, N.C.

FIG. 2. The Next Problem Was a Mechanical One

After my routine analyses really became routine and I felt that the plant was not likely to blow up at any minute, I began to take interest in the various phases of plant operation. There were so many things aside from chemistry that were quite as necessary to know as whether the water was bacteriologically pure. The next problem I was to face was a mechanical one. No doubt the ordinary man would have known all the fundamentals of pumps but they were absolutely foreign to me. Even simple things, such as materials used in pipe lines and their corrosion, were an entirely new field to me but still very essential to know so that I would be able to gage the best quality water I should strive to reach. No doubt I shall never become a mechanical engineer, but at least I do know the difference between a centrifugal pump and a positive displacement pump, and I believe this is an accomplishment of sorts.

Aside from a chemist and a mechanic it seemed I was destined to become "troubleshooter" for the city in general. This activity rapidly expanded to include textile mills, diesel filter manufacturers, and most anything else that might even faintly resemble the field of chemistry. One time I was even asked to be a combustion engineer and burn an enormous pile of sawdust without generating heat. The one which had me completely stumped though was the diesel oil filters. Somehow I never did exactly see how I was to determine their efficiency when only given a set of unidentified numbers set up by some government bureau of standards as a guide. In this instance I had to admit defeat, though in most

FIG. 3. I Was Destined to Become a Trouble-Shooter

other cases I was at least able to offer some degree of advice.

Never a Dull Moment

Other problems I encountered would have probably been quite easy for a man in the job—such as learning the grades of chemicals and different companies handling them. This was actually a part of my work, since I was in charge of ordering the alum and lime as well as determining the dosages; learning when and how much carbon to use; and the treating of our impounded reservoir. These I took in my stride and my questions could be asked without the apologetic note that had to accompany my earlier queries.

In spite of, or perhaps because of, all the petty annoyances that I have encountered, there have been a great many very interesting and instructive experiences, and I can truthfully say my attempt at being a sanitary engineer has been well worth every bit of energy that has been expended on it.

Report of the Committee on Water Works Practice

FOLLOWING is the report presented to the Board of Directors of the American Water Works Association at its annual meeting on January 17 and 18.

There is included herewith the record of activities of committees organized by the A.W.W.A. which are under the jurisdiction of the Committee on Water Works Practice.

While the war-related demands upon the time of committee members have been severe and have compelled some committees to suspend their activities, substantial progress has been made in many categories. It appears that, during 1944, several committees, presently inactive, will be able to resume their work on behalf of the water works field.

This report also includes records of activities of joint committees of the A.W.W.A. and other associations, as well as committees of other organizations to which the A.W.W.A. has appointed representatives.

Water Works Practice Committees

1. *Deep Wells and Deep Well Pumps:* This committee under the co-chairmanship of J. A. Carr and J. C. Harding, proposes to resume its activities during 1944. A progress report is scheduled for the Conference.

2. *Manual of Water Quality and Treatment:* The stock of the 1940 Edition will probably be exhausted during 1944. The cooperation of the Water Purification Division in the preparation of a revised text of this fine manual is anticipated.

3. *History of Water Purification:* Mr. M. N. Baker delivered the manuscript and illustrative material for the *History of Water Treatment* to the staff during February 1943. Mr. Baker was then paid the sum of $1100 to reimburse him for certain stenographic work and to cover the cost of certain source texts which will later be deposited by the A.W.W.A. as "The M. N. Baker Collection" in the Engineering Library. The Lancaster Press is now printing the book which should issue by mid-year 1944. This *History of Water Treatment* will be a document in which the author and the Association can take pride. Its preparation as well as publication must be considered as a public service, not a commercial venture.

4. *Safe Handling of Water Works Chemicals:* The committee is inactive.

5. *Steel Plate Pipe:*

7A.1–1940 Riveted Steel Water Pipe: A *Standard* adopted in 1940 with no editorial change contemplated.

7A.2–T–1940 Lock-Bar Water Pipe: A *tentative standard* promulgated in 1940. The fact that this class of pipe is seldom installed in recent years leads the committee to anticipate no need to

advance this document to *Standard* status.

7A.3–1940. Welded Steel Water Pipe, 30 Inches Diameter and Over. A *Standard* document since 1940. Emergency alternate provisions in accord with WPB Order L–211 were promulgated July 24, 1943 and published in the September and October, 1943 issues of the JOURNAL. The committee has under consideration certain detailed revisions of 7A.3.

7A.4–TR–1943. Steel Water Pipe, up to 30 Inches Diameter. A 1941 standard which has been revised, approved by the Board, and published as a *tentative revised standard* in the April 1943 JOURNAL. Emergency Alternate Provisions in accord with WPB Order L–211 were promulgated June 19, 1943 and published in the September and October issues of the JOURNAL. The committee is considering a definite limitation for the inward protrusion of welds since excess protrusion interferes with lining. Issues have arisen because of the deviation of L–211 from 7A.3 and 7A.4 in the matter of designation of "pipe size" in certain diameters by outside rather than inside dimensions. Since the terms of L–211 govern steel pipe during the war; and further, since the amount of pipe authorized for water works installation has been limited; the discussion has not been pressed. There is no intention, however, of permitting the A.W.W.A. to be maneuvered into an unintended modification of methods of designation of pipe size. Generally speaking, a water works engineer, when he speaks of pipe size, is expressing a concept of *inside* diameter whether it be cast-iron, concrete, steel or any other type of pipe. There are some deviations from this, but changes in existing terminology, if and when made, should tend to bring the present deviations into accord with present routine rather than set up added deviations from conventional terminology.

7A.5–1940. Coal-Tar Enamel Coatings for Pipe 30 Inches Diameter and Over.

7A.6–1940. Coal-Tar Enamel Coatings for Pipe up to 30 Inches Diameter. Adopted as *standard* documents in 1940. No changes as yet recommended. The committee is considering the text of paragraphs relating to a "Soil Stress Rating Test" and a "Water Absorption Test."

During the year, a question was raised concerning the possible limitation of applicability of 7A.5 and 7A.6 because of patents held by the Barrett Division of the Allied Chemical and Dye Corporation. The subject was reviewed by the Chairman, Vice-Chairman and Secretary of the Water Works Practice Committee in a meeting with President Morris, and was subsequently reviewed in a west coast meeting called by President Morris. A complete disclaimer of patent control of the procedures in 7A.5 and 7A.6 has been filed with the Association by the Barrett Division. A copy of the pertinent parts of this communication follows:

"It is this company's policy to prevent the use of basic patents by ourselves or others involving the use of products manufactured by us.

"In 1928, the first pipe was centrifugally lined by the writer in Birmingham, Alabama, and was given sufficient publicity to prevent anyone from securing any basic patents on the process using coal-tar enamels.

"It is possible that some individual might develop and patent a particular type of equipment for the centrifugalization of these materials, but there are

enough methods as described in the A.W.W.A. Specification to satisfactorily permit this to be used without any infringement of some peculiar design that some individual may advance, which would commercially make any patent worthless. Equipment, such as now used by the City of Los Angeles, Western Pipe and Steel, Bethlehem Steel, Chicago Bridge and Iron Company, Hill, Hubbell & Company, and many others, provides a satisfactory job and economics of application and their public use without patented process or otherwise, because of their public use exceeding the three-year U.S. Patent Office requirement. This precludes any opportunity for anyone to establish restrictions on the use of materials as described in A.W.W.A. Specifications 7A.5 and 7A.6. . . .

"I am writing this letter so that there will be no misunderstanding on the patent and legal status of the application of coal-tar materials by the centrifugal process as defined in A.W.W.A. Specifications.

(Signed) GEORGE B. MCCOMB, Mgr.,
Pipe Coating Division, Barrett Division, Allied Chemical & Dye Corp."

7A.7–1941 Cement-Mortar Coating for Steel Water Pipe. A *Standard* document since 1941 with no changes recommended or under consideration.

6. *Reinforced Concrete Pipe:* Tentative Emergency Specifications for Reinforced Concrete Pressure Pipe (7B–T–1943) were approved by this Board by letter-ballot during March 1943 and were published in the April, 1943 JOURNAL. No record of dissent from the terms of these specifications have been filed with the Secretary. The Board will be asked at the time of the 1944 Conference, to approve these specifications as *Standard,* provided that no substantial written record of dissent has been filed in the meantime. Mr. Ernest Whitlock, who developed the document as it now stands, has been charged with the task of preparing tentative specifications for pre-stressed concrete pipe. A committee should be set up to carry on this work under Mr. Whitlock's chairmanship.

7. *Laying Cast-Iron Pipe:* The Specifications for Laying Cast-Iron Pipe which were adopted by this Board in April, 1938 after pre-publication in the February, 1938 issue of the JOURNAL, have received wide acceptance. Progress made in the water main sterilization procedure strongly indicates the need for revision of portions of the present standard. Other sections of the text merit restatement. Mr. W. C. Mabee who rendered such valuable service in preparing the present standard has asked to be relieved of the chairmanship of this committee. The committee is therefore being reorganized and charged with the revision of the Specifications for Laying Cast-Iron Pipe.

8. *Fire Hydrants, Sluice Gates and Valves:* The committee on these subjects, as presently organized, is not actively engaged in revision of the current specifications.

The Tentative Specifications for Sluice Gates (7F.2–T–1941) have not been advanced to *Standard* since their publication. This document does not appear to have been given the consideration it merits. Mr. Conard and his committee devoted much time to the development of the text. It should be appraised by water works engineers and either advanced to *Standard* or exceptions to the text filed with the A.W.W.A.

It appears advisable to activate two separate committees—one to consider the Hydrant Specifications and the other to consider the Valve Specifications.

First, with relation to Hydrant Specifications, the question related to test of strength of the stem, raised by the N.F.P.A. committee, should be considered professionally; the differences of opinion adjusted; and a text satisfactory to all concerned developed. Mr. Earl Norman of Kalamazoo, has published an article in *Water Works Engineering* which strongly criticizes the method outlined in the present specifications for determining pressure loss in a hydrant. These recorded issues make it necessary to set up a separate committee on Hydrant Specifications charged with the task of preparing, during the coming year, a revised text of documents 7F.3–1940. Incidental to this, the committee should consider the permanent value, if any, of the terms of WPB Order L–39.

In the matter of water works valves, questions derived from the terms of L–252 require formal consideration. Objection has been filed by the Secretary to a proposal of the Federal Specifications Editor to write the terms of L–252 permanently into valve manufacturing practice at once. The new A.W.W.A. committee should therefore study the limitations of L–252 from the viewpoint of their possible danger to long term service of water works valves and prepare a statement which can be accepted by the Water Works Practice Committee and your Board. This committee could also, at a later date, give consideration to the suggestion made by Director Piatt, that the A.W.W.A. develop standard dimensional specifications for flanged gate valves for water works service. The proposal has much merit, but the problem of the committee will rest more in adjustment of manufacturers practice than in the development of adequate strength and weight for such valves.

9. *Location Records and Maintenance of Mains and Services:* This committee is not engaged in revision of the earlier report, since no suggestions have been made concerning the need for revision. It is worth noting that the Repair and Utilities Manual of the U.S.Army includes much of this committee's report and that the forthcoming OCD Manual on "Water Works Engineering in Disaster" also quotes from it to a substantial degree.

10. *Steel Standpipes and Elevated Tanks:* The revised documents (7H.1–1943) was publshed (by reference to the amended portions) in the JOURNAL for December, 1942. It was approved by this Board in October 1942, and the New England Water Works Association in September, 1943. The fully revised text is now available as a separate document. When the availability of steel makes it possible to erect steel water storage tanks, the revised document will be of great value.

The committee is engaged in a revision and extension of the section of the document relating to the painting of new tanks. A preliminary report is anticipated at the time of the 1944 conference.

This committee rendered further and conspicuous service to the Association by the preparation of "Tentative Recommended Practice—Repainting Elevated Storage Tanks (7H2–T–1943)." A formal statement on behalf of the Association has been strongly indicated for some time since repainting has been confused with repair by many water works executives who,

unwittingly, made contracts combining repair and repainting to the disadvantage of their community. The report of the committee has already been published in the JOURNAL (July 1943), given further circulation in reprint form, republished by two Sections (Minnesota and Indiana) and by an independent conference (South Dakota).

11. *Pipe Line Coefficients:* No progress is reported.

12. *Distribution System Safety:* The chairman of this committee, Wm. E. Stanley, is in military service and the activities of the Committee had been suspended for the duration. It may become necessary for the A.W.W.A. to reactivate this committee promptly in order that the emerging Regulations and Standards of the U.S.P.H.S. be given consideration by responsible water works executives. Your Board will be asked to consider a series of Emergency Sanitation Standards now placed by the U.S.P.H.S. before state and municipal health authorities for adoption. These, in combination with certain items in the 1942 Drinking Water Standards place the water supply system in a difficult, if not legally untenable, position. The considered opinion of this Board is required (see page 213).

13. *Cross Connections:* This committee is presently cooperating with the Sub-committee on Cross Connections and Back-flow Prevention of the Sanitary Engineering Committee of the National Research Council. The committee proposes to present an interim report on the status of cross-connection control at the 1944 conference.

14. *Fire Prevention and Protection:* No committee work is in progress.

15. *Meters:* The Tentative Specifications for Meters (7M.1–T–1941) are being held in suspense for the duration. The terms of L–154 required the promulgation of emergency alternate provisions (December, 1942). Present availability of bronze suitable for meter bodies indicates the propriety of modification of L–154 insofar as the requirement of iron bodies for meters is concerned.

16. *Service Line Materials:* Wartime conditions make progress of this committee impossible. The chairman proposes renewed activity when conditions permit.

17. *Recommended Standards for Threads for Underground Service Line Fittings:* The New England Water Works Association has appointed a cooperating committee. Chairman Brush proposes to initiate committee activity this spring and to hold a meeting of the committee members at the time of the 1944 conference.

18. *Recommended Design for Valve Boxes & Covers Meter Boxes and Covers:* Chairman Amsbary reports that relief from wartime activities makes it possible for his committee to take up its assignment actively this year. The N.E.W.W.A. has appointed a committee to cooperate in this project.

19. The N.E.W.W.A. was asked to accept the emergency alternate provisions for Hydrants, Valves and Meters. No reply was received.

The N.E.W.W.A. has approved the revisions in the Specifications for Elevated Tanks.

On January 20, 1944 (after the consideration of the report by the Board) the N.E.W.W.A. Executive Committee appointed committees to cooperate with the A.W.W.A. in development of specifications for (1) Steel Pipe and Castings, (2) Reinforced Concrete Pipe, and (3) Laying Cast-Iron Pipe.

Water Purification Division Committees

20. *Zeolites:* The Tentative Manual of Zeolite Test Procedures (5Z–T) was published in the June issue of the JOURNAL. No adverse comments concerning this document have been received. The text as it stands, is, however, only partial coverage of the group of exchange materials. The Water Purification Division, therefore, should continue its committee on this subject and take account of future developments during its technical sessions.

21. *Permissible Loadings and Capacities of Water Treatment Plants:* This committee is actively at work on the project now under the Chairmanship of Douglas Feben.

22. *Water Conditioning Methods to Inhibit Corrosion:* This committee has suspended its activities for the duration.

23. *Filtering Materials:* This committee's Tentative Standard Specifications were approved in March 1943 and were published in the JOURNAL for April, 1943. No comments have been filed.

24. *Control of Chlorination:* This committee's important report has been approved and was published in the October, 1943 issue of the JOURNAL. Copies have been filed with the Editorial Committee on Standard Methods for the Examination of Water and Sewage.

25. *Specifications and Tests for Water Purification Chemicals:* Since the material to be produced on this subject matter should be published in the revised Manual of Water Quality and Treatment, the Committee on Water Works Practice advises the Water Purification Division to distribute sections of the preliminary report of this committee to individual members of the Division for review and editing. It is advisable to assign the direction of this project to the Secretary of the Division.

Finance & Accounting Division Committees

26. *Committee Activities:* The committees of this Division—the *Committee on Joint Administration and Collection of Water and Sewer Accounts,* and the *Committee on Lien Laws,* are not active under wartime conditions. The Division has been authorized to set up a committee to consider "Methods of Comparison of Water Rates."

Joint Committees

27. *Standard Methods for the Examination of Water and Sewage:* The current (Eighth) Edition of Standard Methods was issued in 1936. As of the end of 1943, 16,148 copies have been sold or distributed to reviewers, special libraries, etc. There remain 958 unsold bound copies for sale and no more copies of this Edition will be printed. The Joint Editorial Committee, under the Chairmanship of Dr. J. F. Norton is bringing to a close the preparation of the text of the Ninth Edition.

The first edition of Standard Methods was issued by the A.P.H.A. in 1904. In 1925, the A.W.W.A. became a joint sponsor of the document and subsequent editions have been prepared by a joint committee representing the two associations. The Federation of Sewage Works Associations has formally advised that, while its member-committee will make available

material prepared by it for inclusion in the Sewage Section of the Ninth Edition, the Federation wishes hereafter to participate as a co-sponsor of the text. The Federation has been advised that when the time comes for organization of a joint editorial committee for the Tenth Edition, its participation as a co-sponsor will be fully and cooperatively considered.

28. *Boiler Feedwater Studies:* Except for annual meetings of the Executive Committee, this joint committee has suspended its activities for the duration.

29. *Coordinating Committee on Corrosion:* The work of this committee continues as a clearing house of information concerning corrosion studies.

30. *Construction Contracts:* The work of this committee has been suspended for the duration.

31. *American Research Committee on Grounding:* A progress report of this committee is now being reviewed. A meeting of representatives of the water works field is to be held on January 21st at which time the pending report as well as future activities of the joint committee will be considered. The A.W.W.A. research project on Grounding at New York University has been completed. It will be published, in abstract form, in the March 1944 JOURNAL.

32. *Glossary of Water Control Engineering Terms:* Arrangements are in development for the employment, during 1944, of an editor to prepare this document for publication. An informal understanding related to the printing and distribution of this text has been reached. It is proposed to print 32,000 copies of the text and distribute copies (paper covered) to members of the constituent associations at no charge. The A.W.W.A. will receive 6,000 copies which will suffice for the present membership and permit mailing a copy without charge to each new member for the next year or two. The A.W.W.A.'s share of the estimated editorial cost will be $600 (1944) and its share of the estimated printing cost (in 1945) $1800. Mailing costs will be at second class postage rates.

33. *Accounting Manual:* No revision is in progress.

34. *Survival & Retirement Experience with Water Works Facilities.* The work of this important committee is moving toward completion and reports covering retirement experiences in several cities will be published in the JOURNAL during 1944. The Depreciation Committee of the National Association of Railroad and Utilities Associations has prepared a report and issued it for review. A special meeting of the A.W.W.A.–N.E.W.W.A. executive sub-committee on Survival and Retirement is being held to consider the N.A.R.U.C. report in the light of studies made by water works engineers.

35. *Field Welding of Water Pipe Joints:* A preliminary report of the joint A.W.W.A.–A.W.S. committee has been prepared and is being reviewed by the committee. It is probable that this report will be submitted for approval during 1944.

A.W.W.A. Representation on Committees of Other Organizations

U. S. Bureau of Standards

36. *Simplified Practice Committee on Wrought Iron and Wrought Steel Pipe, Valves and Fittings.* No activity during 1943.

American Standard Association

37. *Cast-Iron Pipe and Special Castings* (A21): No documents have been received from this committee during 1943. The Specifications for Tar-Dip Coatings remain in the unfinished category until full consideration has been given to the paper by Messrs. Lenhardt and Garrity. Preprints of the paper are to be sent to a small group for discussion. No action upon the recommended specifications is indicated prior to the 1944 conference.

38. *Manhole Frames and Covers* (A35): The committee is inactive.

39. *Plumbing Equipment* (A40): F. M. Dawson reports that revision of the preliminary drafts of Plumbing Codes is now in progress and that these documents should be completed within the next few months. The report of the Sub-Committee on Air Gaps and Backflow Preventers was published in June, 1943 as document A40.6. (It has been noted that a joint committee of the A.P.H.A., A.W.W.A., N.E.W.W.A., on "Control of Cross Connections and Plumbing Hazards" which was established in 1937 has been inactive since the organization of ASA A40 was revised. The secretaries of these associations have therefore recorded the dissolution of their joint committee.)

40. *Pipe Threads* (B2): A revision of the 1942 report of this committee is in preparation.

41. *Pipe Flanges and Fittings* (B-16): The following Standards have been approved during 1943:—American Standard for Ferrous Plugs, Bushings, Locknuts, and Caps approved in October; American War Standard—Pressure Ratings for Cast-Iron Pipe Flanges and Flanged Fittings Class 125 approved April 15; American War Standard—Pressure-Temperature Ratings for Steel Pipe Flanges, Flanged Fittings, and Valves approved January 26. A Proposed Revision of American Standard Cast-Iron Pipe Flanges and Flanged Fittings, Class 250 has been circulated but no final action has been taken to date.

42. *Pressure Piping* (B31): The committee has prepared and is now voting on certain proposed revisions to American Standard Code for Pressure Piping (B31.1–1942). Many of the proposed revisions are in the nature of emergency wartime measures. Others are editorial changes. Two new special sub-committees are being appointed to function under the procedure of Sectional Committee B31. One of these sub-committees will formulate requirements for instrument piping; the other will develop quality factors for castings and working stresses for steel castings, forgings, plate and bars.

43. *Standardization of Dimensions and Materials of Wrought Iron & Wrought Steel Pipe and Tubing* (B36): The Sectional Committee has under consideration the proposed submittal of Tentative Specifications A106–43T to the American Standards Association for reapproval as American Standard. This specification will replace the previous specification, ASTM A106–42T, Tentative Specifications for Lap-welded and Seamless Steel Pipe for High-Temperature Service. Other editorial changes have been suggested by Sectional Committee B36 for steel pipe specifications.

44. *National Electrical Code* (C1): On account of the war, the Electrical Committee of the National Fire Protection Association which prepares and issues the National Electric Code has

had no meetings. An emergency committee which acts for the Electrical Committee during this emergency has had several meetings during the latter part of 1942 and 1943. This emergency committee has adopted a number of interim amendments to the Code. Interim amendment and interpretations have as far as possible, been kept in line with the demands of the material shortages, etc., of the war effort. In the Supplement to NBFU Pamphlet No. 70 dated April 1, 1943, are given all such amendments and interpretations to that date.

45. *Zinc Coating of Iron and Steel* (G8): No revisions of existing standards completed during 1943. Early in 1944 revisions of G8.3—American Standard Spec. for Zinc-Coated (Galvanized) Iron or Steel Telephone and Telegraph Line Wire; G8.9—American Standard Spec. for Zinc-Coated (Galvanized) Iron or Steel Farm-Field and Railroad Right-of-Way Wire Fencing; G8.10—Spec. for Zinc-Coated (Galvanized) Iron or Steel Barbed Wire; and G8.11—Spec. for Zinc-Coated Steel Wire Strand (Class B and Class C Coatings) were accepted by the ASA Council.

46. *Letter Symbols and Abbreviations for Science and Engineering* (Z10): No activity.

47. *Sieves for Testing Purposes* (Z23): No activity.

48. *Graphical Symbols for Use on Drawings* (Z32): A report on Graphical Symbols for Electronic Devices was approved by the committee during 1943.

National Fire Protection Association

49. The A.W.W.A. has representatives on four N.F.P.A. *Committees:—Forests; Hydrants, Valves & Pipe Fittings; Public Water Supplies for Private Fire Protection;* and *Tanks.* The Association's representatives advise that none of these committees have been active during 1943.

American Welding Society

50. *Inspection of Welded Structures* (R–12): The text of "Recommended Practice for the Inspection of Fusion Welding" was published in the 1942 Edition of the A.W.S. Welding Handbook. The committee is at present inactive.

Advisory Members on Special Committees

51. *New York City Board of Health:* Following the appointment (by request) of an A.W.W.A. representative to this committee (to advise on matters concerning anti-corrosion treatment of interior water piping) the representative was not called upon for advice. So far as can be learned, the committee was never called upon by the Dept. of Health and as of the present time, the Department does not consider that such a committee exists.

Respectfully submitted,
MALCOLM PIRNIE, *Chairman*

Report of the Publication Committee

1. The Journal

a. Text Contents: During 1943 the JOURNAL contained 1676 pp. of papers and abstracts. Included were these reports:

(1) Public Health Service Drinking Water Standards

(2) Manual of Recommended Water Sanitation Practice Accompanying United States Public Health Service Drinking Water Standards (1942)

(3) Report of the Committee on Water Works Practice

(4) Progress Report (1942) American Research Committee on Grounding

(5) Tentative Standard Specifications for Filtering Material—5C–T

(6) Tentative Revision of Standard Specifications for Steel Water Pipe of Sizes up to but Not including 30 Inches

(7) Tentative Emergency Specifications for Reinforced Concrete Pressure Pipe

(8) Michigan Water Works School on Wartime Maintenance of Water Service

(9) Tentative Manual of Zeolite Test Procedures

(10) Illinois Section Committee Report on Control of Water Well Drilling

(11) A.W.W.A. Tentative Recommended Practice—Repainting Elevated Steel Tanks and Water Storage Tanks

(12) A.W.W.A. Tentative Standardization Procedure

(13) A.W.W.A. Constitution and By-Laws (With Proposed Amendments)

(14) Aims and Objectives of the Inter-association Committee on Water and Sewage Works Development

(15) Emergency Alternate Provisions to A.W.W.A. Steel Pipe Specifications

(16) Committee Report on Control of Chlorination

(17) A.W.W.A. Emergency Alternate Provisions for Thicknesses of Steel Pipe

(18) Current Activities of the A.W.W.A. Steel Water Pipe Committee

The Report of the Audit of Association Funds was published in the March JOURNAL. The December JOURNAL included: The Report of the 1943 Conference; List of Papers Scheduled at Section Meetings; and the Table of Contents and the Index for the year.

There were 190 articles published in the JOURNAL, in addition to the items cited above. Of these, 129 articles were Conference or Section Meeting papers or contributions emanating from the field; and 61 articles were releases from WPB, Selective Service, etc.

b. Abstracts: There was a total of 243 pages of abstracts published in 1943.

c. Advertising: Actual space total of advertisements was 539¼ pages in the 1943 JOURNAL, compared with 468 in 1942, and 490 in 1941. The amount of space contracted for 1944 by Jan-

uary 10 was 430 pages. Since the total volume of advertising is never contracted by this date, anticipated renewal of contracts terminating during 1944 warrants the expectation of at least as much space sale as last year.

d. Total Pages: The total of the above cited, including the News of the Field and the official information at the front of the JOURNAL, was 2552 pages. In 1942, the JOURNAL including the special booklet containing J. A. Krug's Chicago address, totaled 2956 pages. Part of the reduction derived from the desire of the Editor to cooperate with the W.P.B. in reducing the use of paper and part from the change in format which was put into effect at the beginning of 1943.

e. Format: The 1943 JOURNAL text page contains 1.18 times the number of words printed on the 1942 page. This means that 2000 pages of text in the 1943 JOURNAL would have required 2360 pages in the 1942 type face and format. There have been many favorable and no unfavorable comments concerning the change in the appearance of the JOURNAL page.

f. The Lancaster Press has given satisfactory service in printing the JOURNAL during 1943. In making this statement, consideration is given to the problems facing any printing establishment. Manpower and materials shortages have made production problems very severe. Serious delays, even interruption of publications of some periodicals have occurred during 1943. Staff changes in the A.W.W.A. office and personnel adjustments at Lancaster have combined to delay several issues of the JOURNAL, but at no time has a cooperative attitude been lacking.

A definite financial saving has resulted from the change in printers. The extraordinary growth of the Association during 1943 has made a substantial increase in the month to month publication order. In 1942, the monthly publication rate ranged from *4900* in January to *5300* in December. In 1943, the monthly publication rate ranged from *5373* in January to *5900* in December.

The total cost of the JOURNAL production in 1942 was *$23,902.69*, in 1943 *$24,177.09*.

The unit costs of the JOURNAL for 1942 and 1943 were:

1942

No. of pages produced	14,441,500	
No. of journals produced	61,150	
Cost of JOURNAL		$23,902.69
Cost per 1,000 pages		1.655
Cost per copy		.381

1943

No. of pages produced	14,441,688	
No. of journals produced	67,993	
Cost of JOURNAL		$24,177.09
Cost per 1,000 pages		1.743
Cost per copy		.357

Effective with the February 1944 issue of the JOURNAL, the printer's charges for composition, press work and mailing operations, will be increased 10 per cent over the 1943 figure.

g. Paper Stock: During 1943, it was possible to stock, in advance, a year's supply of text and cover stock. The latest WPB order does not prevent the duplication of this in 1944, but as yet the paper producer has not accepted our order for the needed stock. He has, however, advised that the price for paper will be raised 22 per cent. No way to circumvent this condition has been found.

h. Censorship: For the first half of 1943, the Association continued its practice of cooperating with the BEW, which for the period March 1942–June 1943 examined magazines containing technical, scientific or professional data in advance of distribution, and granted a censorship license after approval by the Board. After July 1, 1943, this practice was suspended, but a new plan was put into effect under which all publications available to the general

public in the United States may be exported without licenses, if they contain nothing that violates the voluntary Code of Wartime Practices for the American Press. This voluntary Code was formulated by the Office of Censorship, Byron Price, Director.

A completed copy of the JOURNAL is sent each month to the District Postal Censor in New York City, accompanied by a letter listing appropriate authority for all material covered by provisions of the Code. Violations of the Code of Wartime Practices are called to the attention of publishers by the Press Division, Office of Censorship. The Association has not committed any violations, and has obtained written permission from the proper authorities in advance of publication of any doubtful material. The JOURNAL is mailed only to the United States and Allied Nations.

2. Membership Directory

The 1944 membership directory will issue about mid-year. The directory will be limited by war time production conditions to the information essential to the permanent records of the Association.

3. Index to Journal

This text covers the material published from 1881 through 1939. One thousand copies were printed in 1940. Thirty-one copies were sold in 1943 and 356 copies remain in stock.

4. Standard Methods for the Examination of Water and Sewage

Reference to this activity is made in the report of the Water Works Practice Committee. The Association has found the relationship established with the A.P.H.A. through this publication the source of professional pride. The text is used and accredited internationally.

5. Manual of Water Works Accounting

Forty copies of this text were sold by the A.W.W.A. during 1943. This document should be the guide for the accounting staff of every water utility. It is difficult to understand why water works executives have not more widely applied it to their operations.

6. Specifications

Few large lot Sales of Specifications were made during 1943. Many small lot sales to Federal agencies and the contractors on war construction indicate the high standing of A.W.W.A. specification documents.

7. The Manual of Water Quality and Treatment

This was sold to the extent of 535 copies during 1943. Only 514 copies of the text remain from a total printing of 3000 copies. Steps should be taken to develop a revised text during 1944 which can be published for sale during 1945. A text of this character requires frequent revision and its merit as a guide in water treatment depends upon its being kept fully abreast of the advances in the field.

Respectfully submitted,

LINN H. ENSLOW, *Chairman*

January 17, 1944

Drinking Water and Sanitation Standards

IN the December 10, 1943, issue of Public Health Reports, there appeared the text of a series of sanitation standards which had been developed within the U.S. Public Health Service and which is proposed for adoption as a Sanitation Code by cities or states.

As an alternate they are suggested for adoption by State Boards or Departments of Health.

There are nine main sections of the text covering water supplies; sewage and industrial wastes and excreta disposal; milk and milk products; frozen desserts; eating and drinking establishments; swimming and bathing places; refuse, garbage, rubbish and ashes; sanitation of habitable buildings; and tourist camps, trailer camps, cabin camps, construction camps and similar establishments.

There is reproduced (p. 215–224) the section related to water supplies. Following the text of the section on water supplies, there is published the specimen form of legislative enactment which is presumed to be used when local or state adoption of the Standards is under consideration.

These proposed Sanitation Standards when taken into consideration with the U.S.P.H.S. Drinking Water Standards (1942) present a series of administrative and operating problems to water works executives. The subject was therefore presented to the A.W.W.A. Board of Directors at its annual meeting in New York on January 17, 1944.

The Board received the counsel of a special committee of its members, which group had considered carefully the administrative and public relations problems of water works executives resulting from the promulgation of the 1942 U.S. Drinking Water Standards as well as the current circulation of a series of Emergency Minimum Sanitation Standards proposed by the U.S. Public Health Service for adoption by state and municipal health authorities. Members of the Board expressed the opinion that certain terms of the Drinking Water Standards are so far reaching and drastic as to make it impossible —if the Standards are followed to the letter—to certify any public water supply in the United States as complying with the standards.

Since the Board interprets the attitude of water works executives generally to be that of firm and positive interest in the safety of public water supply and the good health of water users; since it also understands that public water supplies in the United States are generally safe and healthful for human use; the Board concluded that the promulgation of Standards, which by strict interpretation would discredit public water supplies, is not in the public interest and not constructive in advancing public sanitation. The following resolutions were adopted:

Resolution Relating to Public Health Service Drinking Water Standards

Whereas, the 1942 Standards of Quality of Water for Use on Interstate Carriers published by the U.S. Public Health Service have been generally distributed and considered by water works officials, and

Whereas, the Board of Directors of the American Water Works Association has had an opportunity to secure a reflection of opinion of its members upon the practicality of application of these Standards, and

Whereas, certain features of these Standards are objected to because of their rigidity and lack of assignment of a sufficient degree of judgment to the reporting agency, and

Whereas, the American Water Works Association desires to cooperate with local, state and federal health agencies in a program of water works betterment and such program should have the united support, so far as possible, of the water works profession, therefore

Be It Resolved

(1) That the attention of the Surgeon General of the U.S. Public Health Service is invited to the following sections of the 1942 Standards which, in the judgment of the Board of Directors of the American Water Works Association should be reconsidered:

a. Sections 1.6 and 2.2 dealing with the definition of the water supply system.

b. Section 3.1 dealing with frequency of sampling water supplies.

c. Section 4.1 dealing with physical characteristics of water.

d. Appendix containing "Manual of Recommended Water Sanitation Practice."

(2) That the Surgeon General is requested to appoint representatives of the U.S. Public Health Service to confer with a committee of the American Water Works Association relative to the provisions and implications of these sections of the Standards with a view to modifications.

Resolution Relating to Emergency Minimum Sanitation Standards

Whereas, the "Emergency Minimum Sanitation Standards" issued by the United States Public Health Service for proposed adoption by local or state agencies, include standards pertaining to sanitation of public water supplies in which water works officials charged with the administration of public water supply systems are deeply concerned, and

Whereas, these "Emergency Standards" are really peace time standards with a few modifications to meet temporary war time changes, and

Whereas, the American Water Works Association has not had the opportunity to consult with the United States Public Health Service on these Standards, therefore

Be It Resolved

(1) That the Board of Directors of the American Water Works Association requests that the Surgeon General of the United States Public Health Service call for the appointment of an advisory committee on which might be representatives of the American Water Works Association, the Conference of State Sanitary Engineers, the American Public Health Association, and other interested agencies to review these Minimum Standards with a view to preparation of recommendations for revisions if such revisions appear desirable, and

(2) That pending such review, the Board of Directors of the American Water Works Association recommends that local or state adoption of these Minimum Standards be postponed, and

(3) That copies of this resolution shall be forwarded to all state sanitary engineers.

Emergency Minimum Sanitation Standards*

Introduction

General.—These Emergency Minimum Sanitation Standards * constitute the third edition of the Sanitation Code for State or Local Adoption. The first edition was released in December 1940, and the second edition in May 1941, under the latter title. In this third edition the title has been changed to Emergency Minimum Sanitation Standards Recommended for State or Local Adoption, because this title expresses more correctly the purpose for which these Standards are intended.

It is realized that the development of Standards having general applicability is difficult. These Standards have been reviewed by interested official agencies and many suggested changes have been made. Nevertheless, it is probable that conflict with State or local legislation in some instances may be encountered which would prevent adoption of these Standards without modification. In such instances it is hoped that these recommended Standards will serve as a guide in the preparation of applicable State or local regulations.

War emergency.—Reference is made in various places in these Standards to materials that should be used or are preferable. It is realized, however, that during the war emergency some of the materials specified may not be obtainable. Use of substitutes will be necessary, therefore, in such instances in accord with the program of conservation of critical materials for the direct war effort.

Part I

Water Supplies

SECTION 1. *General.*—Every drinking, culinary, and ablutionary water supply which is hereafter constructed, or extensively reconstructed, or every existing water supply which in the opinion of the State health department is unsafe, or subject to the danger of contamination by reason of unsatisfactory location, protection, construction, operation, or maintenance, shall be made to comply with the requirements of these Standards. No such water supply shall hereafter be constructed or reconstructed without the approval of plans and specifications by the State department of health and without a written permit from said department.

* Published in Public Health Reports for December 10, 1943 (**58**: 1793) and reproduced for the information of the water works field by permission of the U.S.P.H.S.

SECTION 2. *Public water supplies.*—All water supplies available to the public shall comply with the requirements of the State department of health, and shall meet the requirements of the United States Public Health Service for common carrier water supplies.

SECTION 3. *Quasi-public and private surface water supplies.*—Surface water supplies shall comply with the requirements of the State department of health and shall meet the requirements of the United States Public Health Service for common carrier water supplies.

SECTION 4. *Quasi-public and private ground water supplies.*—Ground water supplies shall comply with the requirements of the State department of health and shall meet the requirements of the United States Public Health Service for common carrier water supplies, and the following requirements:

Item 1. *Location of water source with respect to potential contamination.*—Every well or spring shall be located and constructed in such manner that neither underground nor surface contamination from any cesspool, privy, or other possible source of pollution can affect such water supply. The horizontal distance from any such possible source of pollution shall be as great as possible, but in no case less than 50 feet, except as provided under item 2, or except as otherwise specified by the State or local health officer. If bacteriological examinations or other evidence indicate actual or potential pollution, the distance shall be increased or the location of the water supply changed, as may be required by the health officer.

The top of every pump room floor, pump platform, or cover of a ground water supply should not be less than 2 feet above the highest known water level of any lake, pond, stream, or any body of surface water, the water of which at the highest level would approach within 50 feet, measured horizontally, of such ground water supply. Wherever possible the ground water source should be located on higher ground than any source of contamination.

Item 2. *Sewerage near wells or springs.*—No floor drain, soil pipe, main drain, or other pipe which is directly connected to a storm or sanitary sewer, or through which water or sewage from any source may back up, shall be located nearer than 20 feet to any well, spring, or other source of water supply. All pipes and drains or parts thereof through which sewage or waste water flows, or into which sewage or waste water may back up, which are located within 50 feet of any such water supply, shall be constructed of extra heavy cast-iron soil pipe or cast-iron water pipe with leaded joints, or be of equivalent construction in the opinion of the State department of health or local health department having jurisdiction.

Item 3. *Leakage from toilets and sewers.*—No toilet, sewer, soil pipe, or drain shall be located over or where leakage therefrom can reach any water storage basin, reservoir, source of water supply, or pump room.

Item 4. *Pits near water supply.*—There shall be no pits or unfilled space below level of ground surface, any part of which is within 10 feet of such water supply, except well, pump, or valve pits conforming to the requirements of item 9.

Item 5. *Well casing or lining.*—All that part of the suction pipe or drop pipe of any well within 10 feet of and below the ground surface, and prefer-

ably within 20 feet, shall be surrounded by a watertight casing pipe extending above the ground, platform, or floor surface as the case may be, and covered at the top as required by items 7 and 8. In certain types of wells, and frequently in reconstructing old wells, the above-mentioned watertight casing may be of smaller diameter than an existing or newly installed lower casing below the ground surface, and not connected thereto. In such instances the lower casing shall be cut off at least 10 feet below the ground surface and the annular space at this cut-off point, between the lower and upper casings, shall be closed with a suitable watertight cover over which shall be placed a compact earth fill to prevent settling at the ground surface: *Provided*, That a dug well, in lieu of such casing pipe, may be provided with a substantial watertight lining of concrete or vitrified tile, with outer concrete lining 6 inches thick, or other suitable material. Such lining shall extend down for a distance of at least 10 feet and shall extend up to the well platform or pump room floor with a watertight connection. In such case the platform or floor shall have a suitable sleeve pipe surrounding the suction pipe or drop pipe and projecting above as herein provided for a casing pipe. With the approval of State health authorities, the impervious lining of dug wells in particular instances may be of lesser depth.

Item 6. *Cover or floor.*—Every well, spring, or other structure used as a source of water, or for the storage of water, shall be provided with a watertight cover; such covers and pump room floors shall be constructed of concrete or similarly impervious material so as to provide proper drainage from the cover or floor and prevent contamination of the water supply. Such cover or floor shall be constructed so that there are no copings, parapets, or other features which may prevent proper drainage, or by which water can be held on the cover. Well casings shall project at least 6 inches above ground level or the top of this cover or floor, and the cover or floor shall slope away from the well casing or suction pipe in all directions. Dug well linings shall extend at least 6 inches above the ground surface and cover installed thereon. The cover shall be watertight, properly grouted in place, and its edges shall overlap at least 2 inches over the walls or curbings of such wells.

Item 7. *Hand pump head and base.*—Every hand-operated pump shall have the pump head closed by a stuffing box or other suitable device to exclude contamination from the water chamber. The pump base shall be of solid one-piece recessed type of sufficient diameter and depth to admit the well casing as hereinafter provided. The top of the casing or sleeve of every well equipped with such a pump shall project into the base of the pump at least 1 inch above the bottom thereof and shall extend at least 6 inches above the level of the platform, well cover, or pump room floor on which the pump rests. The pump shall be fastened to the casing or sleeve by means of a flange connection, and shall not be attached to the platform. The annular space between well casing and suction pipe shall be closed to prevent entrance of contamination. In wells located where frost heaving occurs, or in wells constructed with a buried concrete slab, the well casing, where it passes through the concrete well cover slab, shall be incased in suitable plastic and impervious material not less than

one-half inch thick. (A high-grade roofing cement or similar material which remains plastic at low temperatures, and is readily applied by troweling, is a suitable material.)

Item 8. *Power pump base.*—Where power pumps are placed directly over the well, the pump shall have a solid, watertight, metal base without openings, to form a cover for the well, recessed to admit the well casing, and the well casing shall project into the base at least 1 inch above the bottom thereof, and at least 1 inch above the level of the foundation on which the pump rests, which in turn shall be at least 5 inches above the top of the cover or floor; or, in lieu of such base, a separate watertight metal cover or other watertight closure in which the casing projects in like manner may be used. Where power pumps are not placed directly over the well, the well casing shall extend at least 6 inches above the floor of the pump house. The annular space between well casing and suction pipe shall be closed to prevent entrance of contamination: *Provided,* That the base or cover may have an air vent constructed as hereinafter prescribed.

Item 9. *Well, pump, valve, and pipe pits.*—No wellhead, well casing, pump, pumping machinery, valve connected with the suction pump, or exposed suction pipe, shall be located in any pit, room, or space extending below ground level, or in any room or space above the ground which is walled in or otherwise enclosed, so that it does not have free drainage by gravity to the surface of the ground: *Provided,* That this shall not apply to a dug well properly constructed as herein prescribed, nor to private supplies serving an individual dwelling.

The requirements of this item shall be enforced only for water supply structures which are installed subsequent to the adoption of these Standards, but existing pits may be accepted provisionally only if constructed in accordance with the requirements of the State department of health.

Item 10. *Manholes.*—Manholes may be provided on dug wells, reservoirs, tanks, and other similar water supply structures. Every such manhole shall be fitted with a watertight collar or frame having edges which project at least 6 inches above the level of the surrounding surface, and shall be provided with a solid watertight cover having edges which overlap and project downward at least 2 inches around the outside of the frame. Such covers shall be of standard design whenever possible to eliminate special fittings. The cover shall be kept locked at all times except when necessary to open the manhole.

Item 11. *Vent openings.*—Any reservoir, well, tank, or other structure containing water for any such water supply may be provided with vents, overflows, or water-level control gages constructed so as to prevent the entrance of birds, insects, and contaminating materials. Openings or vents shall face downward and shall be not less than 2 feet above the floor of a pump room, the roof or cover of a reservoir, the ground surface, or the surface of other water supply structures.

Item 12. *Air-lift systems.*—The air intake for any air-lift system or mechanical aerating apparatus shall be at least 6 feet above the floor surface if indoors, and 10 feet above the ground if out-of-doors, and at such elevation as to prevent flooding. The air intake shall be so constructed as to prevent the entrance of birds, insects, and contaminating materials. Every air-lift sys-

tem shall be equipped with effective oil traps, tanks, or filters to prevent oil or other contaminating materials from entering the water.

Item 13. *Lubrication of pump bearings.*—Pump bearings situated in any well below the pump-room floor shall be lubricated either with water from the well or some other approved source, or lubricated in such other manner as may be approved by the State department of health.

Item 14. *Priming of power pumps.*—Water for priming pumps on any water system shall be taken directly from the reservoir or distribution system which is supplied with water from the original source of water supply or from another supply approved by the State department of health. Priming devices shall be so constructed as not to expose the water to dust, drippings, or other sources of contamination.

Item 15. *Priming of hand pumps; buckets.*—Hand-operated pumps shall have cylinders submerged so that priming shall not be necessary. No pail and rope, bailer, or chain-bucket systems shall be used.

Item 16. *Treatment or abandonment of unsatisfactory ground water supplies.*—Ground water supplies which do not comply with the bacteriological requirements recommended by the United States Public Health Service for common carrier water supplies shall be treated by methods approved by the State department of health; if it is impossible to secure compliance with said requirements, said water supply shall be abandoned. All abandoned wells shall be sealed to protect the water-bearing formation against possible contamination:

(*a*) Drilled, cased, and driven wells shall be completely filled with neat cement grout, concrete, or clean puddled clay.

(*b*) Dug or bored wells shall be completely filled with clean puddled clay or its equal after as much as possible of the curbing is removed.

SECTION 5. *Disinfection of new or accidentally contaminated water supplies.*—New water supplies and water supplies which may have become contaminated accidentally or otherwise shall be thoroughly disinfected with chlorine before being placed in use. The rate of chlorine-water mixture flow shall be in such proportion to the rate of water entering the pipe that the chlorine dose applied to the water entering the pipe shall be at least 50 ppm. Treated water shall be retained in the pipe long enough to destroy all nonsporeforming bacteria. The period shall be at least 3 hours and preferably longer, as may be directed. After the chlorine-treated water has been retained for the required time, the chlorine residual at pipe extremities and at other representative points shall be at least 5 ppm. If the residual is less than 5 ppm., the disinfection procedure shall be repeated until a 5 ppm. residual is obtained, as required above. Upon completion of the disinfection process the water containing residual chlorine should be flushed from the system and water samples should be collected for bacteriological examination. The supply should not be used until the tests show that the water conforms to the bacteriological requirements of the United States Public Health Service Drinking Water Standards.

SECTION 6. *Connection with unsafe water sources forbidden.*—There shall be no cross-connection, auxiliary intake, bypass, backflow connection, or other arrangement including overhead

leakage whereby unsafe water, or water from a source that does not comply with these requirements, may be discharged or drawn into any drinking, culinary, or ablutionary supply which does comply with these requirements.

Item 1. *Definitions.*

(*a*) *Cross-connection.*—Any physical connection whereby the approved supply is connected with any other water supply system, whether public or private, either inside or outside of any building or buildings in such manner that a flow of water into the approved water supply is possible either through the manipulation of valves or because of ineffective check or back pressure valves, or because of any other arrangement.

(*b*) *Auxiliary intake.*—Any piping connection or other device whereby water may be secured from a source other than that normally used.

(*c*) *Bypass.*—Any system of piping or other arrangement whereby the water may be diverted around any part or portion of a water purification plant.

(*d*) *Backflow connection.*—Any system of piping or other arrangement whereby the public water supply is connected directly with a sewer drain, conduit, pool, storage reservoir, or other device which does or may contain sewage or other waste or liquid which would be capable of imparting contamination to the approved water supply.

Item 2. No plumbing fixture or device shall be supplied directly from an approved water supply system through a flushometer or other valve unless such valve is installed in a manner such as to reduce to a minimum the possibility of polluting the water supply.

Item 3. No plumbing fixture, device, or construction shall be installed which will provide connection between a distribution system for an approved drinking, culinary, or ablutionary water supply and a drainage, soil, or waste pipe so as to permit or make possible the backflow of sewage or waste into the water supply system.

Item 4. Water from any drinking, culinary, or ablutionary supply complying with these requirements may be supplied to any other system containing water of questionable quality only by means of an independent line discharging at least two pipe diameters and not less than 6 inches above the rim of storage units open to atmospheric pressure or by other methods approved by the State department of health.

SECTION 7. *Outlets from unsafe water supplies required to be sealed or labeled.*—All outlets from water sources which do not comply with these requirements shall be sealed, or, at the discretion of the State or local health officer having jurisdiction, be provided with a permanent and easily readable tag or label reading "UNSAFE WATER. DO NOT DRINK." Removal of said label or tag, except by permission of the health officer having jurisdiction, shall be deemed a violation of these requirements.

SECTION 8. *Distribution and storage.*

Item 1. *Plumbing.*—All plumbing installed for water supply purposes shall comply with the requirements of the Plumbing Manual, National Bureau of Standards Report B. M. S. 66, November 1940, a copy of which shall be on file at the office of....., or its equivalent in the opinion of the State department of health, or as otherwise provided by law. During the war emergency the Emergency Plumbing Standards for Defense Housing (is-

sued by the Division of Defense Housing Co-ordination, Office for Emergency Management, Washington, D.C., 1942) shall be adhered to insofar as use of substitute materials in place of critical materials such as copper and brass and other critical items is concerned.

Item 2. *Plumbing fixtures.*—All plumbing fixtures shall comply with the Federal Specification for Plumbing Fixtures, March 30, 1940, WW–P–541a, a copy of which shall be on file at the office of....., or its equivalent in the opinion of the State department of health, or as otherwise provided by law. The requirements of this specification with respect to air gaps and backflow preventers shall be strictly enforced.

Item 3. *Common drinking cups.*—The use of common drinking cups is forbidden.

Item 4. *Drinking fountains.*—Drinking fountains shall meet the following requirements adopted by the Joint Committee on Plumbing of the American Public Health Association and the Conference of State Sanitary Engineers, and shall comply with Federal Specification WW–P–541a of March 30, 1940.

(*a*) The fountain should be constructed of impervious material, such as vitreous china, porcelain, enameled cast iron, other metals, or stoneware.

(*b*) The jet of the fountain should issue from a nozzle of nonoxidizing, impervious material set at an angle from the vertical such as to prevent the return of water in the jet to the orifice or orifices from whence the jet issues. The nozzle and every other opening in the water pipe or conductor leading to the nozzle should be above the edge of the bowl, so that such nozzle or opening will not be flooded in case a drain from the bowl of the fountain becomes clogged.

(*c*) The end of the nozzle should be protected by nonoxidizing guards to prevent the mouth and nose of persons using the fountain from coming into contact with the nozzle. Guards should be so designed that the possibility of transmission of infection by touching the guards is reduced to a minimum.

(*d*) The inclined jet of water issuing from the nozzle should not touch the guard and thereby cause splattering.

(*e*) The bowl of the fountain should be so designed and proportioned as to be free from corners which would be difficult to clean or which would collect dirt.

(*f*) The bowl should be so proportioned as to prevent unnecessary splashing at a point where the jet falls into the bowl.

(*g*) The drain from the fountain should not have a direct physical connection with a waste pipe, unless the drain is trapped.

(*h*) The water supply pipe should be provided with an adjustable valve fitted with a loose key or an automatic valve permitting the regulation of the rate of flow of water to the fountain so that the valve manipulated by the users of the fountain will merely turn the water on or off.

(*i*) The height of the fountain at the drinking level should be such as to be most convenient to persons utilizing the fountain. The provision of several steplike elevations to the floor at fountains will permit children of various ages to utilize the fountain.

(*j*) The waste opening and pipe should be of sufficient size to carry off the water promptly. The opening should be provided with a strainer.

Item 5. *Water distribution lines.*—The distribution system shall be de-

signed and constructed so as to prevent leakage of water due to defective materials, improper jointing, corrosion, settling, impacts, freezing, or other causes. Adequate valves and blow-offs shall be provided so that necessary repairs can be made with a minimum interruption of service.

(*a*) *Leakage test.*—Newly laid pipe lines, before covering, shall be tested under a hydrostatic presure 50 per cent in excess of the normal operating pressure after expelling all air from the pipe. The duration of each pressure test shall be at least 30 minutes.

All exposed pipes, fittings, valves, hydrants, and joints should be carefully examined during the open trench test. All joints made with lead showing visible leakage should be recaulked until tight. Where the joints are made with sulfur compound or with cement and show seepage or slight leakage only such joints as may be defective should be cut out and replaced. Any cracked or defective pipes, fittings, valves, or hydrants discovered in consequence of this pressure test should be removed and replaced with sound material, and the test should be repeated until the pipe installation is satisfactory.

Suitable means should be provided for determining the quantity of water lost by leakage under normal operating pressure. No pipe installation should be accepted until or unless this leakage (evaluated on a pressure basis of 150 pounds per square inch) is less than 100 gallons per 24 hours per mile of pipe per inch nominal diameter for pipe in 12-foot lengths, 75 gallons for 16-foot lengths, and correspondingly varied for other lengths of pipe. In calculating leakage, allowance should be made for added joints in the pipe line above those incidental to normal unit lengths of pipe.

(*b*) *Water pressure.*—The piping system shall be designed and installed to maintain a positive pressure in all its parts under normal usage at all times.

(*c*) *Dead ends.*—The system should be designed so as to afford effective circulation of water with a minimum of dead ends. All dead ends of sizes larger than 1½ inches in diameter shall be equipped with blow-offs.

(*d*) *Jointing materials.*—Jointing materials shall be free from oil, greasy substances, or tar and shall be disinfected and kept free from contamination and applied dry. They shall be of a character such as not to foster the growth of coliform bacteria.

(*e*) *Water lines near sewers.*—Water and sewer lines shall be laid in separate trenches and at least 10 feet apart. Where a water service pipe crosses a street sewer at less than 6 feet vertically above the sewer or is within 10 feet of it horizontally, all that part of the water pipe lying within these distances should be constructed of copper or brass pipe connected to the iron pipe with a brass fitting. In such cases it is preferable to use copper or brass pipe from the water main to the house, and the house sewer should be constructed of extra heavy cast-iron pipe with watertight joints. Where critical materials cannot be obtained, due to the war emergency, extra heavy iron pipe should be used in place of copper and brass pipe.

(*f*) *Stream crossings.*—Where it is necessary to lay water supply lines across streams, an overhead crossing should be made whenever this is feasible. If overhead crossings cannot be provided, special precautions should be observed to prevent the entrance of

surface water into the water supply line, and to prevent damage to the line by currents, ice, floating objects, anchors, dredges, etc. Laying the line at least 5 feet below the bottom of the body of water, use of flexible watertight joints, and cradling the pipe in concrete are items requiring consideration in such installations. If the crossing is a vital part of the water supply system, consideration should be given to construction of underwater crossings in duplicate to assure continuity of service.

(*g*) *Sanitary conditions surrounding water pipes and pipe laying.*—Where avoidable, water pipes shall not be laid in water or where they can be flooded with water or sewage in laying. When necessary to lay water pipes below the water table or in wet ground, additional protection shall be provided for the joints, to insure watertightness to the satisfaction of the State or local health officer having jurisdiction. New water mains shall be flushed thoroughly through hydrants or other approved means to remove all dirt and foreign matter. The mains shall then be disinfected in accordance with the procedure set forth in section 5 of this part of the Standards. New mains should not be put into service until satisfactory bacteriological results are obtained as required in section 5.

Item 6. *Storage.*—All reservoirs, cisterns, and storage tanks shall be of watertight construction and made of concrete, steel, or wood: *Provided,* That when such reservoirs or storage tanks are buried in the ground or located underground, wood shall not be used therefor. All such storage units shall be properly covered to avoid contamination and shall be so located or protected that there will be no danger of contamination by surface drainage or flooding.

SECTION 9. *Bacteriological examinations.*

Item 1. *Collection of samples*—Water samples for bacteriological examinations shall be collected in accordance with the directions accompanying the sterilized bottles obtained from the State department of health or other laboratories approved by the State health officer. Care should be taken to obtain a sample that is truly representative of the water to be tested and to see that no contamination occurs at the time of filling the bottles or prior to examination. Samples should be collected preferably by trained personnel.

Item 2. *Shipment of water samples.*—The samples shall be labeled definitely as to source, date, and time of collection. All samples should be examined as promptly as possible after collection. The time allowed for storage or transportation of a bacterial sample between the filling of the sample bottle and the beginning of the analysis should not be more than 6 hours for impure waters and not more than 12 hours for relatively pure waters. During the period of storage, the temperature should be kept between 6°C. and 10°C. Any deviation from the above limits shall be so stated in making reports.

Samples of any disinfected water supply must be freed of any disinfecting agent within 20 minutes of the time of their collection. (In freeing samples of chlorine or chloramines, the procedure given in the Standard Methods for the Examination of Water and Sewage, eighth edition, 1936, published by the American Public Health Association, par. A–1, option 1, or par. A–2 shall be followed.)

Short Enabling Forms Suggested for Local and State Adoption of These Minimum Standards

For use in case of local adoption:

"Be it ordained by the (city, county, district) or (name of political subdivision) that the Emergency Minimum Sanitation Standards recommended by the U.S. Public Health Service [1] shall be in force with the ..... of ..... and its police jurisdiction from and after ....from the date of adoption of these Standards."

For use in case of adoption by the State Board of Department of Health: [2]

"Under authority of (give authority here) the (name of State) (name of official health agency) hereby promulgates the Emergency Minimum Sanitation Standards recommended by the U.S. Public Health Service,[1] which shall be enforced by all local health authorities having jurisdiction in all or parts of such areas as may from time to time be designated by said (name of official health agency) and by the said (name of official health agency) in all parts of such areas which are without local health service."

---

[1] Political subdivisions in which adoption of legislation by reference is not considered legal should adopt the Emergency Minimum Sanitation Standards, parts I to IX, which follow.

[2] The phraseology of this paragraph should conform to the legal usage of the State concerned.

Abstracts of Water Works Literature

Key: In the reference to the publication in which the abstracted article appears, **34:** 412 (Mar. '42) indicates volume 34, page 412, issue dated March 1942. If the publication is paged by the issue, **34:** 3: 56 (Mar. '42) indicates volume 34, number 3, page 56, issue dated March 1942. Initials following an abstract indicate reproduction, by permission, from periodicals, as follows: *B.H.—Bulletin of Hygiene (British); C.A.—Chemical Abstracts; P.H.E.A.—Public Health Engineering Abstracts; W.P.R.—Water Pollution Research (British); I.M.—Institute of Metals (British).*

FOREIGN WATER SUPPLIES—GENERAL

Presidential Address. Institution of Water Engineers. SIDNEY R. RAFFETY. Wtr. & Wtr. Eng. (Br.) **46:** 240 (June '43). Spirit of co-operation between neighboring water undertakers has become increasingly marked; hope it will not prove mere war effort. In considering future activities of Inst., question should be raised why it exists, particularly now since Inst. of Civ. Engrs. setting up special divs. One of foremost problems is increasing consumption per head and large increase during recent years of peak which has now reached alarming proportions. Author convinced all supplies will have to be metered. Suggest that authorities might consider how to make shower bath popular, since they consume only fraction of water used in fixed bath. Though few illicit garden waterers caught by inspectors, "snooping around" not pleasant. Remedy against frost is initial internal plumbing and insulation of pipes, together with education of consumer. Little or no exptl. or research work in water works carried on in this country except by mfrs. Situation wrong. Setting up of research station must be matter for water works authorities as a whole. Many instances among smaller water works where management "rule of thumb" variety. Matter so closely affects health that chance ought not to be taken. Closely connected with qualifications is matter of salary.—*H. E. Babbitt.*

The Water Resources of Loch Quoich. W. N. MCLEAN. Wtr. & Wtr. Eng. (Br.) **46:** 361 (Sept. '43). Loch is 6 mi. in length, ½ mi. wide, has water surface of 2¾ sq.mi., surrounded by mts. 3000′ or more in height, collects runoff from about 50 sq. mi. Annual avg. rainfall 111″. Flow of Garry R. shows runoff 89″ from 150 sq. mi. in avg. yr. Direct runoff from mts. steep and short. On any loch, rate of drop in water level, spread over surface area, measure of excess of outflow over inflow. In case of "cradle" loch, when inflow has dropped to small amt., drop in loch becomes nearly measure of rate of outflow. Smooth curve of drop is $dh = \frac{1}{4}(h + 12)^2 \div 100$, where h is water level in in., and dh is rate of drop in in. per day. Procedure adopted for computing outflow from fall of loch level during dry weather includes: (1) rate of drop of water level; (2) inflow to loch; (3) increase of loch surface area in relation to height of water level; (5) measure of loch outflow at any level of loch; (6) residual runoff; (7) variations of inflow; and (8) compilation of records of water level and runoff. Flood of Dec. 20, '36 stands out prominently in record. It produced on Moriston R. flood equiv. to runoff of 4″ per day. Highest aggregate rainfall of Quoich area is $R = 0.0094T + 1.125T + T^{0.5}$ in., where T is time in hr. Data as to max. runoff most important point in detg. capac. of reservoir necessary to meet supply during long periods of drier years which have occurred in this part of Scotland. *Discussion. Ibid.* **46:** 434 (Oct. '43). Continuous records of data involved in hydrological and meteorological knowledge can be portrayed scientifically only by aggregate diagrams on which various data brought together in proper relationship. Inflow graph gives better indication of incidence of rainfall than obtainable

from daily values of rainfall. By means of aggregate diagram natural inflow of high flood may be apportioned to any size reservoir and outflow channel and effect of storage on outflow peak detd. DAVID LLOYD: Although author infers that estd. values of rate appear to agree with conditions in outflow channel, work seems to require outflow being gaged for verification. Author gives value of peak inflow which is exceptional value—over 600 cfs. per 1000 acres—double value of normal max. floods shown in interim report of Com. on Floods. CHARLES LAPWORTH: Author gives table showing reservoir storage required to give various rates of supply and states that values probably applicable to most areas with avg. rainfall of over 40". Tested values given and found figures for storage required much too low. *Ibid.* **46:** 476 (Nov. '43). *Author's Closure:* My general statement that Garry comparisons of supply and storage can be applied to other areas entirely wrong. Dry-periods' diagram has to be constructed first, and relationship of supply to storage may be read off without difficulty. Vyrnwy data permit correct dry-periods' diagram being constructed.—*H. E. Babbitt.*

Water Supply and Disposal of Sewage in Paris. F. LANGBEIN. Zbl. Bauverw. (Ger.) **23:** 416 ('41); Wass. u. Abwass. (Ger.) **39:** 178 ('41). Avg. daily demand for water in Paris and its suburbs is 285 l. per cap., of which 95 l. untreated water for indus. use and 190 l. drinking water. 500,000 cm. of daily supply spring water and require no special treatment; 250,000 cm. ground water treated with chlorine to remove iron where necessary. Rest of water supply (400,000 cm. per day) taken from Seine, Marne and Oise and filtered. Filter plants, greatly enlarged in recent years, can treat 1.3 mil. cm. per day—greatly in excess of usual demand. In emergency, therefore, all water supply could be taken from rivers. Rate of flow through prelim. filters is 25–40 m. per day and through main filters 7–10 m. Aluminum sulfate added occasionally either before pumps for raw water or after primary filters. Filtered water chlorinated. Ozone plant which can treat 300,000 cm. water daily recently put into operation experimentally. Filters consist of layers of sand 0.5–0.7 m. deep on beds of permeable concrete; particles of sand 0.3–3.0 mm. in diam. Filters washed mechanically. Plan to supply city with 1 mil. cm. water per day from Loire through main 200 km. long not carried out owing to high cost. Sewerage system and treatment of sewage in Paris described and compared with those of Berlin.—*W.P.R.*

Tewkesbury Water Works. ANON. Wtr. & Wtr. Eng. (Br.) **46:** 423 (Oct. '43). Capac. of existing works of Cheltenham Corp. was 2 mgd. (Imp.). Increased by 2 mgd. authorized and in constr.; provision for further increases authorized. Plant includes 3 river intakes, steam pumping plant, alumina house, sedimentation tank to deal with 2 mgd. (Imp.), 6 paterson filters designed for nominal rate of 58 gal. (Imp.) per sq.ft. per hr., with air and water wash. Slow sand filters installed at various dates from 1869 and discontinued in '33. In new works water taken from Severn R. and pumped to sedimentation tank with prelim. chem. treatment. After settlement it passes through filters, is sterilized and gravitates to pure water tanks, then pumped to service reservoirs. From reservoirs it gravitates to distr. systems of Cheltenham and Gloucester. Raw water contains, in ppm., total hardness 270 to 50, alky. 170 to 30, total solids 410 to 130, turbidity 3000 to 11, and pH value from 8.8 to 7.0. Pump house steel-framed on reinforced concrete tanked basement. Low-lift and high-lift pumps centrifugal. Raw water pumped to flash mixer where chems. added. Filter house similar in design to pump house. Pure water tank of concrete with capac. of 250,000 gal. (Imp.).—*H. E. Babbitt.*

Baghdad District Water Board. *Report for Year Ended March 31, 1942.* ANON. Wtr. & Wtr. Eng. (Br.) **46:** 339 (Aug. '43). Restrictions due to war necessitated cessation of extension of mains for supply of unfiltered water for gardens. Reduction in applications for filtered water reduced extensions to ⅓ of those made in previous yr. Consumption continues to increase at steady rate. In Jan. record cold spell damaged water meters of which 1020 had to be removed. Meters recently purchased from Palestine had no frost protection. Consumption continues to increase at steady rate and indicates extensions of filtration and pumping will be necessary by '44. Water pumped during yr. totalled 9.475 mil. cu.m., increase of 9.6% over previous yr. 97.2% of 1491 bact. samples found free from *Esch. coli* in 100 ml. samples. Raw water from Tigris R. gave avg. colony count of 31,900 per ml. Filtration reduced no. of colonies 265 times, and filtration plus chlorination 2380 times. No. of broken mains increased considerably, generally due to settlement. No. of service

pipe leaks extremely high. Steel pipe with security wrapping pits, wrapping having fine cracks through which moisture in ground can come into contact with pipe.—*H. E. Babbitt.*

Iodine Addition to Drinking Water Supply in Holland. AUG. F. MEYER. Gas-u. Wasserfach (Ger.) **84:** 690 ('41). Supply from deep wells contained so little I considered desirable to add KI at rate of 1 kg. per day to avg. of 2200 cu.m. of water. In Germany, iodine not added to water supplies, but iodized salt distributed in certain localities where water supply low in iodine.—*C.A.*

Water Supply in the Tropics. H. M. FINLAY. Wtr. & Wtr. Eng. (Br.) **46:** 191 (May '43). Source of Trinidad central water-supply scheme is impounding reservoir in Northern Range, with capac. of about 1050 mil.gal. (Imp.). No habitation allowed on catchment area. Water treated in pressure filters with alum and chlorination. Trunk mains deliver water to 13 service reservoirs, most distant of which is 45 mi. from source. Scheme designed for peak output of 5.2 mgd. (Imp.) Samples for bact. testing taken regularly. During '41, results which had been satisfactory, deteriorated. Chloramine treatment adopted. Residual chlorine, which had previously disappeared in first 2 mi., found 12 mi. from source. Appears to be spreading gradually. Chloramine treatment proved especially valuable in Trinidad owing to unusual length of trunk mains.—*H. E. Babbitt.*

The Water Supply of the Town of Locarno. G. ALLIATA. Monatsbulletin (Swiss) **18:** 283 ('38); Gesundh.-Ing. (Ger.) **63:** 47 ('40). Describes geology and sources of water supply of Locarno. Supply derived from 1 main spring and 2 smaller springs from which water flowed to high-pressure tank. In winter of '29 supply proved insufficient and pumping plant added for spring water; well also constructed to serve part of dist. under low pressure. Well yields abundant supply of water with total hardness of 6° (Fr.)—*W.P.R.*

Water Supply in the Administrative District of Trèves. MAYBAUM & HENTSCHE. Dtsche. Wasserwirtschaft (Ger.) **598** ('41); Wass. u. Abwass (Ger.) **40:** 34 ('42). Increased demand for water on western frontier of Germany caused by massing of troops in dist. met by taking water from streams and treating it for disinfection, by boring of wells and utilization of springs, and by obtaining supplies from munic. authorities. Assumed that demand of military would be at least equal to that of civilians and program of constr. drawn up on that basis, which included both small supplies and large group schemes. When program complete, no. of communities in admin. dist. of Trèves without central water supply will be reduced from 22.5 to 5.8%; water supplies unsatisfactory from bact. point of view will be reduced from 51.8% before '38 to 26.8%. No. of communities which have central water supply and yet suffer from lack of water will be reduced from 49.2 to 16.8%. Bldg. program covers 267 communities and will cost about 19.3 million RM.—*W.P.R.*

The Drinking Water Supply of the Village of Hartheim in the District of Freiburg. H. KAISER. Zbl. Ges. Hyg. (Ger.) **47:** 427 ('41); Wtr. Poln. Research (Br.) **14:** 355 (Dec. '41). Village of Hartheim, southwest of Freiburg, obtains its water supply from old dug wells and from driven pipe wells. Situation of 38 of wells examd. and water anald. chemically and bacteriologically. Nearly all wells examd. undesirably situated, though bact. examn. did not always confirm presence of poln. None of wells fulfilled hygienic requirements and some dangerous to health. Constr. of central water supply only method of improving conditions. —*P.H.E.A.*

The Drinking Water Supplies of the Villages of Oberrimsingen and Gretzhausen. B. BREIL. ('39); Zbl. Ges. Hyg. (Ger.) **47:** 426 ('41); Wtr. Poln. Research (Br.) **14:** 355 (Dec. '41). Villages of Oberrimsingen and Gretzhausen (combined pop. about 600) obtain their water supplies from driven pipe wells, 7–8 m. deep, fed with ground water from heights of Black Forest. Examns. made of 38 of these wells, about ¼ of total no. Normal chloride content of ground water of dist. known, and content of chloride greater than 20 mg./l. regarded as indication of poln. by sewage. Considered that permanganate demand should not be greater than 12 mg./l. or content of nitrates greater than 30 mg./l. Permissible bact. count fixes at 100/ml. and absence of *Esch. coli* in 1 ml. required. Among 38 wells, 60.5% regarded as insan. because of their situation, 81.5% because of bad bact. qual. of water and 36.8% because of bad chem. qual. Conditions in many ways very primitive and advisability of connecting villages to neighboring water supply stressed.—*P.H.E.A.*

WELLS AND GROUND WATER

Notes on the Early History of Water-Well Drilling in the United States. CHARLES W. CARLSTON. Econ. Geol. **38:** 119 (Mar.-Apr. '43). Std. cable-tool drilling rig invented and developed in drilling salt wells in W.Va.-Ohio-Pa. region during 20 yr. following successful completion of first drilled well in 1808 by Ruffner Bros. at Great Buffalo Lick near Charleston, W.Va. Sometime previous to 1823, Levi Disbrow studied drilling methods used in western salt indus. and came East as first professional water well driller in states north of Potomac R. Possibly first artesian water well in U.S. constructed in 1820 in Charleston, S.C. by sinking iron pipe through clay bed. Auger boring for artesian water appears first used in Charleston, S.C. in 1823. First successful auger-bored well, however, not completed there until after 1825. Drilling methods and tools copied from description of well bored in London, England. Between 1821–33 auger-bored artesian wells began in Black Belt of Ala. and possibly Miss. Process of jetting wells, invented in 1884, became chief method of sinking artesian wells in Atlantic and Gulf Coastal Plain by end of century. First successful artesian wells in Ga. and Fla. put down during 1880–82.—*Ralph E. Noble.*

Increasing Water-Well Yields. *A Symposium.* Over the Spillway (Ill. Dept. of Health) *No.* 4: 32 ('42). W. J. SCHNEIDER: Dry ice used successfully many yr. to increase yields in many wells over 1000′. In acid treatment of drift wells at Lawrenceville, drop-pipes and foot valves removed and cleaned mechanically. Incrustation removed by pumping, then sufficient 25% inhibited muriatic acid (HCl) poured in to make 6–7% soln., circulated 1 day by ditch pump then pumped out and water neutralized with soda ash. Results exceptionally good. Acid cost approx. $275.00 per cwt. R. SENIFF: HCl will not clean out Fe deposits on well casings. Lactic acid, used in oil wells, probably would work efficiently for water wells. Should not use galvanized-iron pipe in acid treatment because of Zn in galvanized coating. In instance of $CaCO_3$ (limestone) plugged well, HCl delivered through black iron pipe. Well top closed tightly to obtain max. effect of gas-pressure released from acid. After latter in 2 hr., water surged 8 hr. Acid removal completion by pump detd. by interval pH tests. Arsenic inhibitor of acid may be very toxic to consumers. Fe dissolved and pptd. during well cleaning may re-cement sand grains and clog well. Possibility elimd., however, by keeping pH at 2.5 or less. 3% acetic or citric acid added to HCl elims. much trouble if Fe in water. HCl used to dissolve sand and shale in oil wells. $CaSO_4$ in wells dissolved by ammonium salts. Use acid sufficiently concd. to complete action. H. WHITE: Cl_2 and acid used to increase yield of wells. Mech. cleaning followed by acid, then Cl_2, in some cases. In others, Cl_2 ahead of acid gave best improvement. Fe and CO_3's principal factors causing reduced yields by "plugging." J. SHIMP: At Naperville, after HCl pump injected, wells sealed by cap reinforced with angle irons. After 24 hr., wells pumped 5 hr., left quiet 4 hr., then again pumped 6 hr. First effluent red, later milk colored. Point of pH fitness for consumption detd. with litmus paper. C. DUY: After carefully studying underground formations on Aurora well, 250 qts. of nitroglycerine, interval spaced, used for "shooting." During later 65-hr. test, 75 cu.yd. of sand baled out. Entire cost approx. $7000 and yield sufficiently increased to retire same in few yr. J. J. WOLTMAN: Many wells prematurely clogged by excessive rate pumpage. Ground-water-supply operators would find advantage in keeping adequate water level records weekly, as these of value in future study of ground water condition. In present day design, larger screen openings provided, if possible. In many cases desirable to pump sand through screens into wells rather than use small ones and risk plugging wells. Many wells drawing water from glacial drift formations, packed with gravel on outsides of well screens.—*Ralph E. Noble.*

Ground Water Studies in Relation to Drainage. J. E. CHRISTIANSEN. Agric. Eng. **24:** 339 (Oct. '43). Irrigation and drainage census shows drainage works constructed on approx. 3 million acres and that like area irrigated wholly or partially by pumping from wells, possibly elimg. necessity for other drainage. Nearly million addnl. acres admittedly need drainage. U.S. Regional Salinity Lab. research directed toward studies having gen. application to salinity problem, including development of methods and equip.

usable by respective states to solve their specific problems, During past yr. piezometers developed and used for studying ground-water flow. Proved quite satisfactory for detg. gen. flow pattern and appear promising as aid in detg. actual permeabilities of soil strata. Drainage design largely empirical. Real need for data on ground-water flow patterns and soil permeability for basis of rational design. Should then be possible to select most practicable drainage methods, to improve drainage design, and thereby drain soils with min. expense, thus preventing unfavorable moisture conditions and salinity increase. —*Ralph E. Noble.*

Ground Water and Relation of Geology to Its Occurrence in Houston District, Texas. NICHOLAS A. ROSE. Bul. Am. Assn. Pet. Geols. **27:** 1081 (Aug. '43). Geol. formations from which Houston dist. obtains water supply are upper Miocene, Pliocene and Pleistocene. These of continental origin and consist of inter-bedded sand, clay and gravel. Section divided into zones by elec. logs. Annual pumpage in Houston and Pasadena areas nearly const. from '30 to '36 but increased about 60% between '37 and '41. From '30 to '36, water levels in approx. equilib. Large pumpage increase caused marked decline in water levels. In Katy area, annual pumpage decreased somewhat from '30 to '35, but increased more than 3-fold from '35 to '40. Net decline in water levels over several yr. Ground water qual. used in dist. compares favorably with other U.S. supplies. Exploratory drilling data show that addnl. ground water supply available west and north of Houston, and that salt-water encroachment from down the dip not likely to occur for many yr.—*Ralph E. Noble.*

Ground Water Characteristics Shown by Well Near Pierre, S.D. ANON. The Clarifier **8:** 1, 2: 2 (Jan., Feb. '43). In central S.D. little, if any, information re qual. and quant. of artesian waters below Dakota and Lakota sandstones. Until recently only 2 wells ever tapped lower formations of this area. In fall, '42, near Pierre, S.D., artesian well drilled 2359′ provided quant. and chem. characteristics of waters from Sundance, Minnelusa and Madison formations. Open flows from these sandstones 1100, 450 and 200 gpm. and well head pressures of 350, 380 and 346 psi., resp. Well casing used: 340′ of 13″, 1494′ of 7″, and 340′ of 4¾″. Temps. ranged from 109°F. in Sundance water to 117°F. in Madison water. Chem. characteristics nearly alike in each case. All high in total solids, sulfates, fluorides, iron and hardness (Ca and Mg). Excessive hardness of about 1200 ppm., or 70 gpg., exceeded by only limited no. of wells in entire state. Because of these high amts. of objectionable chem. components, water from formations in area not recommended for use as potable water supply.—*Ralph E. Noble.*

Ground Water Problems of the Baltimore Area. JOHN C. GEYER. The Driller **17:** 8: 6; **17:** 9: 8 (Aug., Sept. '43). 50 mgd. ground water withdrawal from artesian sources in Baltimore area alarming. Replacing sources as destroyed would require more than $12,000,000 immediate capital expenditure. Economic loss to area if all ground water supplies fail estd. as billion dollars per yr. Complicating factor great lack of data during long withdrawal period. Conservation planning depends upon records of withdrawals, water levels and co-ordinated simultaneous pumping tests throughout area. Hydrology and geol. of problem discussed. Generally true that desired balance in developing artesian or confined ground water, one under which pumping doesn't lower levels to uneconomical depths or draw undesirable water into system from nearby formations or salt-contamd. areas toward natural outlet. To halt drift toward destruction, great enterprise required. Aim will be to limit withdrawals in area to amts. that will not lower pumping levels to uneconomical depths and prevent increased chloride leakage from abandoned wells. Only thus can large part of ground water resource be saved. Main steps in program: (1) accumulate history of every well drilled in area; (2) collect data on wells for study to limit withdrawal quants. scientifically; and (3) seal abandoned wells. Authority exists for such plan in Sec. 3, Ch. 526, Laws of Md., '33, providing power to devise and develop gen. water resources program for state. Latter shall contemplate proper conservation, allocation and development of all surface and underground waters for best interests of Md. people.—*Ralph E. Noble.*

Ground Water Affected by Industrial Plants. FRITZ EGGER. Gesundh.-Ing. (Ger.) **65:** 124 ('42); Chem. Zentr. (Ger.) **II:** 700 ('42). Sewage seepage from plant treating gas tar and filling of land with refuse from plant treating gas liquor caused gas odor and

taste, increased NH_2 content and increased hardness of ground water. Seepage of pickling waste from broken pipes caused increased hardness, increase in Fe content from 3 to 235 mg./l., leaching of plant wastes and slag, and economic waste in removal of iron from ground waters as well as death of fish in standing waters.—*C.A.*

Rural Water Supply in the Franconian Jura. H. HOLLER. Dtsch. Wasserw. (Ger.) 645 ('41); Wass. u. Abwass. (Ger.) **40:** 34 ('42). Narrow valleys, 200 m. or more in depth, of Franconian Jura region abundantly supplied with water by mountain streams which flow through them, but extensive high plateau very poor in water. All rain water sinks through fissured Jura stone until it either reaches impermeable stratum of Ornaten clay or is absorbed by deep reservoirs of water where Ornaten clay at greater depth below bed of valley. Inhabitants of high land cannot be supplied with water from house wells, because these must be about 150 m. deep and water must be pumped up, which is uneconomic for individual wells. A joint water-supply system has overcome difficulty. Water obtained from valleys partly from springs and partly from wells. Repeated chem. and bact. tests of water of springs in White Jura mountains necessary because many of these springs not only liable to diminution in vol. of flow but also doubtful from hygienic point of view. Water power from fast mountain streams used wherever possible to pump up water. In calcg. demand for water considered that same amts. required for 1 person, 1 head of cattle and 5 smaller animals. First plants based on demand of 50 l. per head (or unit) per day but new plants built to supply 40 l. per person per day on avg. day and 100 l. per person per day on days of high demand. Half pop. of these mountains no longer suffers from lack of water but water-supply problems of this region not entirely solved.—*W.P.R.*

Tube Wells in and Around Calcutta. N. C. BOSE. Mem. Geol. Survey India **76** ('40); Wtr. Poln. Research (Br.) **14:** 358 (Dec. '41). Chem. examn. made of water from tube wells in and around Calcutta. Although water satisfactory by bact. tests, very hard, causing excessive consumption of soap, unsatisfactory for some cooking, tarnishes copper and brass, and, in some of wells, contains sufficient sodium chloride to cause brackish taste. Dist. divided into 4 divs. with different types of water in wells. Water of 1 dist. subsoil water, free from any marine or saline influence; in another part water has variable content of sodium chloride and affected by water from Salt Lake; other wells affected by fresh water of Ganges; and in fourth dist. poln. by sea water produces, in some instances, very brackish water. Salt Lake probably connected with sea; as its waters main factor affecting salt content of wells, there is every likelihood that this content will increase with increasing withdrawal of water.—*P.H.E.A.*

The Nature and Significance of Certain Variations in Composition of Los Angeles Basin Ground Waters. ROY R. MORSE. Economic Geol. **38:** 475 (Sept.-Oct. '43). As to waters found in Pleistocene and Recent beds, *artesian* uniformly low in total solids and high in proportion of CO_3 radicals. *Non-artesian* and runoff strains, more erratic in character and occurrence, reflecting nearby outcrops in higher total solids, particularly Mg, SO_4 and Cl radicals. Pliocene *chloride* waters approach sea water in character but lower in Mg and SO_4, higher in Na and CO_3. From nature and occurrence, major strains meteoric deep-seated waters of more complicated history and connate character, with various mixtures and modifications. 5 unrelated causes of chem. variation recognized: (1) modification of normal meteoric water by base-exchange. Extreme results seen in water compn. generally found in lower San Pedro Pleistocene and in Upper Pleistocene narrow belt along coastal uplift. (2) Sulfate reduction with corresponding CO_3 and H_2S increase, generally in deg. with depth, becoming prominent only in lowest horizons or at structurally high locations; relatively minor factor in modification due to small quants. of SO_4 involved. (3) Appearance in Lower Pleistocene horizons of higher Cl and Mg than normal for artesian waters, changes indicating slight contamn. of modified meteoric with connate sea water. (4) Effect of nearby outcrops in shallow marginal groundwaters in certain restricted circulation areas where Mg, SO_4 and Cl higher than normal. (5) Mixture of modified meteoric and connate waters in pre-Pleistocene oil measures. *Base-exchange* process not now operating as systematic progressive modification accompanying slow oceanward migrating Pleistocene artesian ground waters. Contrarily, effects appear in Upper Pleistocene abruptly along coastal uplift where waters under considerable head, and in lower, persistently

marine facies of Pleistocene wherever wells reach these horizons. Across artesian area Upper Pleistocene beds satd. with unmodified meteoric water of obvious sources showing no progressive changes in compn. until coastal belt reached. Likewise no evidence of systematic oceanward increased base-exchange in deeper horizons. Contrarily, highly modified non-artesian waters found around landward basin margins; highest deg. in Lower Pleistocene and Pliocene horizons near oil fields around eastern rim.—*Ralph E. Noble.*

The Assessment of Percolation. P. G. H. BOSWELL. Wtr. & Wtr. Eng. (Br.) **46:** 466 (Nov. '43). Statement recently made before com. of House of Commons to effect that Parliament has accepted figure of 10″ as annual percolation when underground resources of water being considered. Such statement, if not challenged forthwith, may be quoted again and again. Parliament has never committed itself in this way. Can we arrive at agreement about proportion of rainfall that shall be provisionally allocated to percolation in areas occupied by particular geol. formations? Many percolation gages set up in various countries on different geol. formations. Range of results from less than 20% to more than 80% of rainfall avg. over year. These exptl. results have little or no value. Gage cannot be expected to reproduce avg. conditions of compaction, fissuring, etc. of areas many square miles in extent. Many geologists experienced in water finding protested against adoption of gage results on ground that they were too low. Now to consider indirect method of assessing percolation. If run off and evapn. can be measured or satisfactorily estd., balance may be assumed as percolation. Evapn. cannot be detd. Indirect method fails. Left to draw on experience in different areas. At this stage, may be serviceable to refer to statements made by eminent water engrs. and geologists in past, mainly for purpose of showing how great their differences of opinion. While records from percolation gages vary from 3″ to 18″ at different localities for approx. same rainfall, avg. for large series of observations from Britain and abroad works out at more than 40% of annual rainfall. Better course would be to agree upon percentage of rainfall rather than abs. figure. Author suggests 40% as *pilot* figure to guide deliberations. Should be reduced only if: (1) evapn. can be proved to be higher than avg.; and (2) consideration of local geology based on areal development of different types of rocks, storage capacity, runoff, etc., warrants reduction. Figure should be raised, perhaps up to 50%, in areas: (1) where evapn. does not appear to be excessive, and (2) where ground is mainly or entirely occupied by permeable formations of substantial thickness.—*H. E. Babbitt.*

RATES

Ottawa Suburban Water Rates. ANON. W.W. Inf. Exch.—Can. Sec. A.W.W.A. **5:** D: 4: 22 (Jan. '43). In '40, Ontario Munic. Board Act amended to authorize Bd. to hear application of any municipality concerning water rates charged to it for water supplied by any other municipality, and to fix these rates. First case to be heard, concerning rates charged by Ottawa to Townships of Gloucester and Nepean, Town of Eastview and Village of Rockcliffe Park, abstracted in some detail. In '40, Ottawa claimed that Bd. had no jurisdiction but Bd. ruled to contrary, ruling being subsequently confirmed by Court of Appeal and by Supreme Court of Canada. Proceedings here reviewed continuation of application of municipalities, except Gloucester, which withdrew. Brief presented by Wm. Storrie included following data: Outside municipalities purchase water through meters at respective boundaries and have paid rate of 20¢ per 1000 gal. (Imp.). Ottawa bylaw provides that rate to outside municipalities should be not less than 50% in excess of rate for city consumers. Meter rate to latter 16.82¢ per 1000 and, therefore, outside rate should be not less than 25.23¢. Non-resident individual consumers pay 28¢. During '41, outside municipalities used 2.97% of total water pumped and contributed 6.53% of total revenue received. Per capita consumption in Ottawa since '35 111 gpd. In '41, revenue per 1000 13.33¢, net expenditure 12.73¢ and net surplus 0.6¢. Rates in Ottawa on assessment basis or meter charge, whichever greater. No charge made for fire protection nor for supply of various public bldgs. In '40, only 6.2% city services metered. Reeves Newsom contended that public utility owned by city should be considered as private utility in establish-

ing rate to outside municipality. W. E. McDonald, City Water Works Engr., estd. that water delivered in '41 was 75% of total quant. pumped. He submitted that 24.99¢ would be fair rate to be charged, made up as follows, on basis of '41 operation: cost of pumping, purif. and distr. 8.09¢, capital charges (6% on book cost of plant) 9.43¢, depn. on phys. property (0.89% on appraised value or 1.57% on book cost) 2.47¢, addnl. charge to outside municipalities (25%) 5.00¢. Similar data for '42 would give rate of 25.85¢. He also stated that leakage survey had indicated avg. leakage from system of 27.5%. Bd. did not accept principle that outside municipalities should be charged for water on strictly commercial basis, i.e., that city-owned public utility should be considered private utility in establishing rate and stated it believed city should assume responsibility for supplying water to outside municipalities, more particularly because poln. of river by city renders it non-usable to municipalities downstream. Agreed business of city as to charge for fire protection, free water, size of surplus on water works accts. and disposition of surplus, but found that consideration of these items and revenue side of water works acctg. renders rates charged in Ottawa unsound and unstable basis for fixing of fair rate for outside municipality. Bd. accepted principle of establishing rate on basis of cost of production, i.e., total water produced divided into total expenditure involved in its production. Board also accepted 50% of cost so found as allowance to cover all contingencies, including leakage from distr. system. Avg. net cost of producing water during '36–40 was 12.48¢ per 1000 gal. Addn. of 50% for contingencies gives 18.72¢, rate set by Board. Ruling provides that rate subject to adjustment every 5 yr.—*R. E. Thompson.*

Collections From Summer Services. L. G. SMITH. J. Me. Water Util. Assn. **19:** 123 (Sept. '43). In Kennebunk, Kennebunkport and Wells Water Dist., some owners insist upon tenants paying water bills. Regulations require notification by owner before water turned on, and signed application by tenant with first quarter payment; ¼, if annual basis, or full amt. if summer-season rate. If tenant moves in before regulations complied with, owner held responsible. Greatest problem comes from places on flat or fixture rate. Prior to dist. control, owners allowed to have own gate wrenches for turning on water at street. As some continue practice, every taker on fixture rate billed July 1. Those not planning to use water notify dist. and return bill. All users checked Aug. 1, and adjusted bills rendered. Some owners, anticipating tenants, turn on water but latter not obtained. Nevertheless, dist. insists upon payment. *Grocery Concern Wins Verdict in Water Meter Suit.* $1,828.15 damages awarded A & P Tea Co. for grocery stock loss in Waterville store cellar when dist. water meter broke at store, in decision by Bangor Superior Ct. Justice. Bottom plate of water meter fell out allowing water to enter cellar faster than automatic pump installed by store could remove. Plaintiff contended dist.'s duty to install and maintain sound meter; that if latter broke and flooded cellar, dist. should pay damages. Dist. denied negligence on ground that cause of meter break not proved. As meter made by reliable co., break probably due to some unusual pressure such as turning on and off spring faucets in store. Exceptions to decision filed.—*Ralph E. Noble.*

Wholesale Rate Concessions to Co-operatives Not Unduly Discriminatory. *Highland Utilities Co.* v. *Western Colorado Power Co.* Pub. Util. Fort. **31:** 786 (June 10, '43). Complaint by elec. distributing co. against reduced rates to rural co-op. assn. for wholesale elec. energy dismissed by Com. As long as co-ops. conduct business properly and deliver elec. energy to farms and rural areas not previously served, special classification justified. Com. believed that special classification of REA projects in state by utils. selling current wholesale justified and reasonable discrimination and not unlawful preference to said co-ops.; and would not be in contravention of the state statutes. Irrespective of question of differences in character of service rendered, Com. opinion that such separate classification may be justified on grounds of ability of customers to pay, advantages to public and right of utils. to meet, by low rates if necessary, threat of new competitive generating plants. Rates offered under said schedules may not, however, impose any burden upon other customers of util. and must not be unduly discriminatory or unreasonably preferential to co-ops. Com. ruled that even though govt. interested in REA projects, they were not dept. of govt. but only instrumentality of govt. and as the loans repaid to government, would become property of membership and then would be considered as private corp. Thus, in this

case, doctrine of preferential rates to government not being discriminatory to its competitors did not apply.—*H. J. Chapton.*

Connecticut Public Utilities Commission. *Richard Clarke et al.* v. *Guilford-Chester Water Co.* Pub. Util. Fort. (PUR) **47:** 278 (May 13, '43). Petition for relief from alleged excessive rates based on 10% of cost of extension and for change to rate schedule applicable to household customers in Madison. Water co. extended water main to serve petitioner's property under contract providing owners pay 10% of cost of extension until revenue from customers served should equal said min. 10%. New main later extended under contract with same provisions to adjacent area owned by petitioners. Their revenue never equaled min. guaranty. New mains from terminus of above water main to serve adjacent dist. constructed under identical contract. New dist. revenues exceeded min. Therefore, Madison household rates granted this dist. Petitioners claim that as new dist. served through their main and that all revenue from 3 dists. more than equals 10% min., they should also receive benefit of lower household rates. In '41, water co. brought action against petitioner through New Haven court to recover money due co. by virtue of min. guaranty provision of two contracts. Judgment then rendered in favor of water co. Pub. Util. Com. derives all powers by delegation from General Assembly through statutory provisions and implications reasonably drawn from such statutes. Applicable section of statutes does not appear to give Com. power to modify contract entered into between patron and co. covering special circumstances relating to extensions of utility's service to patrons premises. Obviously, co. could not be expected to extend service to petitioner's premises or be ordered to do so unless extension would be self-supporting. Contract therefore necessary for petitioners to get water and lawfulness of petitioners obligation to pay min. amt. of revenue into indefinite future covered by "escape clause," which terminates obligation when extension becomes self-supporting. Com. has power to remove discrimination between customers similarly situated, but petitioners and customers in general in Madison cannot be said to bear such relationship. Only other relief to petitioners would be through exercise of Com. police power to modify contract rates; but this section of statute relates to general public welfare and not to the hardship of particular customer. This petition appears to set forth circumstances where contracts between petitioner and water co. appeared provident for petitioner at time of their execution, but subsequent events beyond control of either party have rendered contracts improvident. To make contracts provident again, petitioner would borrow from revenues of third extension serving different customers under contract which providently made. Should co. be required to modify contract in manner sought by petitioner, further extensions under similar circumstances would be undertaken with considerable reluctance—or not at all. Com. dismissed petition for lack of statutory power or jurisdiction over subject matter.—*H. J. Chapton.*

Connecticut Public Utilities Commission. Re *New Haven Water Co.* Pub. Util. Fort. (PUR) **49:** 229 (Sept. 16, '43). Hearing before Com. to establish fair rate of return for New Haven Water Co. and confirm new rates put into force Nov. 1, '39. Investigations conducted by Com. over period of 2 yr. Various testimony by engrs. and economists to det. value of co. presented. Com. concluded that rates of co. since Nov. 1, '39 just, reasonable and adequate and no money collected since Nov. 1, '39 need be refunded to customers.—*H. J. Chapton.*

Montana Public Service Commission. Re *Town of Townsend Water Works.* ANON. Pub. Util. Fort. (PUR) **47:** 63 (Mar. 18, '43). Water works, by application on July 9, submitted schedule of flat rates and meter charges for water. Applicant contended that schedule was in fact not raise in rates but method of computation which included all appliances using water. Earnings under new rate schedule would not net utility greater than 6% on net capital invested. Application granted.—*H. J. Chapton.*

The California Commission. Re *Helmer* (Decision No. 35757, Application No. 24334). ANON. Pub. Util. Fort. **31:** 328 (Mar. 4, '43). California Com., in authorizing operation of water util. system, recommended establishment of schedule of flat rates in view of increasing difficulty which even existing water utils. were encountering in attempts to obtain water meters because of scarcity of material.—*H. J. Chapton.*

Public Utility Rates on a Reproduction-Cost-of-Service Principle. JOSEPH FEMING. J. Land and Pub. Util. Econ. **17:** 138 (May '41). U. S. operates under termed capitalistic economy. Private ownership regulated only to extent permitted by law, notable exception being public utility industry. Market price for commodity will, in long run, stabilize at point where it will equal avg. total costs to most efficient producer. Time lag between introduction of more efficient tools of production and effect on market price of goods produced. Improvements in art do not immediately attract new and efficient producer. Must become aware of opportunities; raise investment funds; construct plant; train personnel; and develop business. If theory can be modified by eliminating these intermediate steps, following conclusions may be drawn: Market price at any given time will stabilize at point at which profits will be sufficient to interest investors in most efficient plant. Market price equals sum of operating expenses, taxes and fixed charges, latter including provision for depn. and return on investment. Public utility rates can be determined on this basis. "Reproduction-Cost-of-Service Principle"—gross revenues permitted shall equal total cost of rendering equivalent service by most economical methods in light of existing state of art and market conditions. Principle clear. Even with limitations obviates determining of "going concern value"; "accrued depreciation"; "reproduction cost new"; "aboriginal cost"; "historical cost"; "original cost", and interpretation of "fair value." Major public utilities electricity, gas, water, transportation, and communication. Water almost non-competitive—no substitute. Reproduction cost new of identical water company plant would have to be used in rate detn. Appears simplicity of proposed principle carries penalty of costly and complex methods of practical application, which cannot be considered *a priori* insurmountable. Principle has many advantages which should make it of interest to public utilities and consumers.—*Samuel A. Evans.*

Wisconsin Public Service Commission. Re *City of Wauwatosa.* Pub. Util. Fort. (PUR) **49:** 63 (Aug. 5, '43). City of Wauwatosa filed application for authority to increase rates 1¢ per 100 cu.ft. to customers receiving water supply from Milwaukee Co. water mains in city. Customers desire to retain county water as it is soft, and they do not object to raise in rate. City and county desired rate raise retroactive but Com. denied this request. However, rate raise granted effective for billing period next following date of order.—*H. J. Chapton*

Water Charges in the 30 Largest U. S. Cities. ANON. Barcus, Kindred & Co. (Apr. 1, '42). Range of consumption 3,000 to 5,000,000 gal. per mo. Because supply and treatment costs vary widely between cities, judgment regarding relative rates must allow for costs. Selected monthly bills (net), domestic users:

	Flat rate	*Min. Metered Charge*	*Thousand Gallons Metered* 3	5	10
Min.	$0.70	$0.42	$0.36	$0.34	$0.68
Median	1.13	0.64	0.67	0.97	1.88
Max.	2.00	1.25	1.74	2.43	4.16

Selected monthly bills (net), large users:

	Service Charge-2" Meter	*Charge for 175,000 Gal. Net*	*Per Thousand Gal.*
Min.	$0.98	$11.93	6.8¢
Median	—	28.70	16.4
Max.	4.95	59.02	33.7

Similar data given for 15, 50, 650, 1,000 and 5,000 thousand gallons. Article includes table showing schedule of water (net) rates per 1,000 gal. per mo.; one for cities charging separate sewer rate; one giving ration pop. to users and one with types of accts., basis of classification and billing periods.—*Ralph E. Noble.*

Water Rates. RAYMOND I. CASE. Neb. Munic. Rev. **228:** 2 (July '43). Clarkson, Neb., charges $1.50 per quarter min. for 6000 gal. Excess calcd. at 5¢ per 1000 gal. Rate applies to all users—business houses, homes, industries and for victory gardens. All consumers satisfied.—*Ralph E. Noble.*

Free Water for City Departments Is Rule in 26 Out of 36 Cities. ANON. Western City. **18:** 7: 26 (July, '42). Free water for city services provided in majority of cities in survey of munic. owned water depts. owned by League of Calif. Cities. Fire depts., hydrants, street depts. given free water in 26 of 36 cities covered, with parks, play-grounds, city-owned bldgs. and pub. drinking fountains supplied to some. Basic question in water works manage-

ment involved in selecting method of reimbursing water works for water so used. Where water not provided without cost, regular customer procedures of billing and collection usual. Transfer warrants provided in only few cases. Fire hydrant installation and maint. largely handled by water depts. in cities questioned. Hydrant charges levied in about ⅓ of cities. Percentages of city services receiving free water given, according to city, with method of payment used where water not provided free.—*Ralph E. Noble.*

Extra Charge for Additional Customers Approved. ANON. Pub. Util. Fort. **31:** 393 (Mar. 18, '43). Wisconsin Com. authorizes municipally operated water utility to add to existing schedules charge of 75¢ per quarter for each additional customer supplied through one service. No objection made by Federal Price Administrator or OPA. In aforesaid municipality existed large no. of multiple dwelling units served through single connections; other apartments had no access to water but carried all necessary for their needs. Condition caused by recent influx of war industry workers. All customers supplied on an unmetered basis. Re *North Freedom* (2-U-1872)—"No one has right to service of water util. until he has made his contribution toward cost of operating and maintg. plant ready at all times to serve customers. Customer who supplies neighbor through his service connection deprives utility of its right to collect just share of capacity and demand expenses from those who procure their water habitually from service furnished to their neighbors. Held in so many cases that reasonable charge should be applied to those habitually resorting to services of neighbors or to those takers considered as additional customers on service line that appears reasonable to approve application in this case."—*H. J. Chapton.*

McCook City Water Plant. RAYMOND I. CASE. Neb. Munic. Rev. **229:** 2 (Aug. '43). In '35, McCook had on books over $400,000 of delinquent water bills, due to leniency of city officials and water commissioners in previous years. Elected admin. elimd. elected water comr. and set up bd. of pub. works. New bd. took and kept dept. out of politics 100%; established rule that if water bill not paid within 1 mo. from due date, service discontinued. Many protests but no court actions resulted. In 8 yr., $300,000 in water bills booked and only $9.41 delinquent in July '43.—*Ralph E. Noble.*

TUNNELS AND AQUEDUCTS

New Intake and Force Main for the City of Santa Fe, Argentina. *Design of a Conduit With a Special Section.* FELIX SAN MARTIN. Bol. Obras Sanit. Nacion (Arg.) **6:** 364 (Nov. '42). Difficulty of obtaining sufficient quants. of reinforcing steel and exorbitant prices brought about by scarcity in Argentinan market, made necessary revision of plans for aqueduct required to furnish addnl. water supply to Santa Fe. Original design provided for intake tower in Colastine R., pump suction line 231 m. long, pumping station and 10,640-m. long force main. About 9300 m. of force main spirally and longitudinally reinforced concrete pipe 1.30 m. id. and 0.12 m. wall thickness fabricated in sections 3 m. long. Junction of these sections to be made with spirally and longitudinally reinforced concrete collars. Heavy reinforcement necesary because of high internal pressures and dead and live loads which had to be resisted by structure while empty. Since bulk of 1720 tons of steel required by project needed in force main, decided to revise design to reduce reinforcement. Use of plain concrete forbidden by excessive cross-sections required to withstand high internal pressures. Attempt to bring water to city by means of underground channel from which it could be pumped to treatment plant abandoned when examn. of material to be traversed indicated that project would be difficult and costly. Best solution involved breaking of hydr. grade line at strategic point thus reducing internal pressures at expense of installing, operating and maintg. second pumping station. Computations showed that even with reduced pressures, required plain concrete section unusually heavy. Use of parabolic and oval-shaped sections to obtain better distr. of stresses did not prove much more economical. Best solution obtained with circular section supported by central wall with axis along vertical diam. of pipe. Although resulting structure six times indeterminate, under expected conditions of loading, problem reduced

to anal. of uniform cross-section circular arch with two fixed ends and supporting equal and opposite uniform loads acting laterally on both sides of arch in direction parallel to supporting center wall. Decrease in carrying capac. caused by presence of wall and increase in wetted perimeter compensated for by suitable increase in pipe diam. Principles of elastic energy theory used in rigorous anal. of proposed structure and detailed calcns. of bending and direct stresses indicated for all critical sections. Surge chamber having overflow above highest possible flood flow level of river provided to prevent excessive internal pressures in conduit. Modified design reduced amt. of steel required from 1720 to 100 tons. On other hand, vol. of excavation and amt. of concrete needed increased. Nevertheless, at current market price of steel, conduit will cost ½ million pesos less than reinforced concrete pipe. This saving offset by need of installing and operating extra pumping equip. However, original objective of making a vital project feasible under difficult circumstances attained.—*J. M. Sanchis.*

Well Points De-Water Tunnel. J. F. GEARY. Western Constr. News **18:** 2: 53 (Feb. '43). In connection with sea water pumping project at Wilmington, Calif., tunnel driven below sea level, open to atmosphere and kept dry by well points. Discharge header installed in tunnel, addnl. header sections and well points added as tunnel face advanced. Lined with reinforced concrete, tunnel to carry water from W. Basin, Los Angeles Harbor, to supply cooling water to oil refinery. Considered different methods of dewatering during constr., e.g., deep wells near each tunnel portal or groups of well points sunk in same location, but topography and space limitations unfavorable. Pneumatic methods rejected. *Linear Positions Standardized:* Adopted 2 std. "rings," or circular liner plate sections, "A" and "B." Plate position in each ring detd. as well as relative circumference position of one ring in relation to other. Certain plate in one ring selected through which to insert well point and hole burned through prior to starting work. Hole located to one side of invert center-line to allow room for working runway and 3" pipe coupling welded in each for later plugging, as necessary. Well points spaced 3′ c. to c. longitudinally of tunnel, permitting well points installation to follow tunnel face closely as it advanced. Best overall results obtained by sinking points vertically downward back of face as soon as heading advanced far enough to permit installing point without interfering with work. *Well Point Installation:* Depth of points below tunnel floor detd. by length of well point assembly, in one piece, manageable in tunnel 7′ high. Longest, 8′ from point tip to top of riser pipe. Points jetted into place by usual method. *Header Pipe Installation:* Header pipe supplied in usual 20′ lengths. Impossible to use until tunneling advanced that distance. Meantime, therefore, necessary to use short 3½′ lengths of 8" diam. manifold as discharge header contg. as many well points connections as would 20′ section, and as close together as possible. Manifold installed on end of discharge header with gate valve between. After point installed, piped back with 1¼" pipe to manifold opening, others plugged. After tunnel advanced enough to permit 20′ header pipe, gate valve closed, shutting off all advanced points connected to manifold but leaving all other well points in operation. Connections between manifold and attached well points then broken, manifold removed, 20′ header pipe installed and connected by usual swing joint method to points in place below. Valve opened, connecting this series with those previously installed. Manifold moved forward to end of last 20′ section and operation repeated as tunnel advanced.—*Ralph E. Noble.*

The Hydraulics of the New Pressure Aqueduct of the Metropolitan Water District. KARL R. KENNISON. J. Boston Soc. Civ. Engrs. **29:** *Sec.* 1: 1 (Jan. '42). Constr. of new pressure aqueduct to centers of distr: (1) elims. use of sources subject to poln.; (2) provides addnl. carrying capac.; (3) makes Chestnut Hill pumping station unnecessary; and (4) will ultimately elim. Spot Pond pumping station when distr. loop completed. Middlesex Fells Res. on north, at el. 271, and Fisher Hill Res. on south, at el. 251, supply high level. New Norumbega Res. at el. 274.5 will aid, particularly being at opposite end from Fells Road. Hydr. considerations necessitated placing gradient above intrados of Wachusett Aqueduct. Approach turbulence at archways reduced by thin steel plates. Wachusett Aq. and pressure aqueduct meet at newly-constructed equalizing basin. Backwater affected resulting flows. Future extensions and possible filtration plant studied and design allowed for hydr. loss if and when constructed. Structures designed to permit raising when these

losses require higher gradients. Precast cut and cover pipe 9680′ of 12½′ and 14′ diam. tunnel 15,820′ long. Flat slopes and adequate design to avoid future paralleling of lines made these sizes necessary. Large diam. wyes provided for future extensions on these pipes as well as on 69,000′ of 11½′ pipe. Outlets provided can serve as future suction and discharge to lift water 70′ from Wachusett Aq., el. 200, to pressure aqueduct. Hydr. design provides for adequate low-level mains and certain increases in high-level demand. Weekly avg. demands of 200, 250 and 300 mgd. studied. Bleeding from high service required at times to meet low service demands. Weston Res., being remote, will fluctuate less and less as consumption increases and Spot Pond, for san. reasons, kept in reserve. Reservoirs generally reach min. levels at Friday, 8:00 p.m., each week. 4 critical periods occur in week as gradients fluctuate, but 2 of prime importance. For present and near future, max. elec. power at Wachusett Dam available when most valuable. Norumbega and Weston Res. would be at min. Monday morning, instead of normally being at a max. Nevertheless, max. variation in Norumbega would be only 2.6′. As consumption increases, power generated at Wachusett would gradually become less in value. Pressure aqueduct gradient can be lowered 15′ if Wachusett supply discontinued. Weston Aq. not superseded by pressure aqueduct, but rather reinforces it and is retained as major reserve unit. Careful hydr. computations illustrate low heads available and care in planning. While Chestnut Hill pumping station discontinued, not to be abandoned, as dist. would be dependent on 1 tunnel. Spot Pond pumping station must be continued until tunnel loop and branch line to Fells Res. completed. Spot Pond itself valuable reserve, capable of supplying low service in Boston by gravity, thus being more valuable than Chestnut Hill Res. Pumps could be used to supply northern high service in emergency.—*Charles H. Capen.*

Steel Aqueduct for Alta Gracia. MIGUEL A. SIMEONE. Bol. Obras Sanit. Nacion. (Arg.) **6:** 182 (Sept. '42). Special circumstances made necessary installation of 10 km. of spirally welded steel pipe, varying in diam. from 0.300 to 0.400 m., in place of equal length of asbestos-cement pipe in 17-km. trunk line built to bring water from Anizacate River to city of Alta Gracia. Spirally welded pipe, imported from U.S. prior to America's entry into war, first pipe of this type used by Natl. San. Works Dept. Article describes methods used in pipe coating, transportation and joining 12-m. long pipe sections. Special precautions taken to pack backfill tightly around lower half of pipe to prevent its possible collapse when top backfill load applied. Flexibility of pipe permitted laying on long radius curves without use of special sections. Although line paralleled tortuous mountainous road, rate of pipe laying as high as 250 m. per 8-hr. day. "Dresser" type expansion joints installed at 300 m. intervals. All tests made on line have shown it to give excellent performance.—*J. M. Sanchis.*

Lining Inclined Section of Delaware Aqueduct. CHARLES G. HOERNER. Civ. Eng. **13:** 139 (Mar. '43). Latest addn. to N.Y. City water supply system includes 85 mi. of pressure tunnel known as Delaware Aqueduct, now in final stages of completion. Water from Rondout Reservoir enters two stilling chambers from which it leaves by means of gooseneck connection. From this point, short twin tunnels merge into inclined section of tunnel through series of transitions. With grade of tunnel fixed by distance and el., velocs. kept within safe limits by increasing wetted perimeter, resulting in increase in section area and introduction of longitudinal concrete vanes. Total time spent in concreting inclined tunnel, beginning with mucking invert, was 8 mo., indicating overall avg. progress of 380′ of concreted tunnel per mo.—*H. E. Babbitt.*

War Production Board—Office of War Utilities

Administrative Letter to All Utilities—January 22, 1944

UTILITIES ORDER U-1 AMENDED

AMENDMENT of Utilities Order U–1 [Issued Feb. 24, 1943; amended April 17 and Sept. 24, 1943. *See* p. 670 May; p. 1375 Oct., 1943 JOURNAL.] represents a simplification of the procedures, regulations, and record-keeping required of utilities in connection with the purchase and use of materials for maintenance, repair, operating supplies, and for making minor plant additions under war-time conditions.

Principal Changes in the Order

1. The order has been rearranged and reworded for the purpose of clarification.

2. The quantitative restrictions on "withdrawals" of former paragraph (f) (3), and the controls on "acceptances of delivery" of former paragraph (f) (2) have been eliminated.

3. The limiting dollar value of $500 for overhead construction has been increased to $1,500.

4. Utilities having a total inventory of $10,000 or less, excluding fuel and other materials specifically excluded from inventory by definition in paragraph (a) (11), are no longer subject to the restrictions on inventory and on the dollar value of material that may be purchased under the present order. Such utilities are, of course, subject to the other restrictions of the order; for example, those relating to the construction of lines to serve consumers, economy in the use of materials, sales from inventory and clearances of purchases of certain items through regional inventory control offices.

Detailed Description of Changes—Part I

Significance of changes in definitions. Paragraphs (a) (4) to (a) (10). Definitions of "minor" and "major" plant additions have been added, as well as a definition of "net material cost." The definition of "operating supplies" has accordingly been changed, and the definitions of "maintenance" and "repair" have been modified so that these terms are applicable only to jobs which do not involve a plant addition.

The limiting dollar value for plant additions is set at a flat $1,500 instead of the former limits of $500 for overhead and $1,500 for underground construction.

It is emphasized in paragraph (i) that the $1,500 limit is not applicable in cases where existing facilities are replaced with facilities of an equal or less capacity. Such jobs may be undertaken under Order U–1, regardless of the dollar value of the material used, provided that the restrictions of paragraph (i) are observed. Of course, if material must be purchased for such a job, the dollar value of the purchases must be included in the quotas established for scheduled deliveries.

Extensions of lines to consumer premises. Paragraph (i) (4). In cases where the proposed minor plant addition is an extension of a line to a consumer, the job must qualify under the provisions of the applicable supplementary order or must have been specifically authorized on Form WPB–2774. For your information, we are enclosing a chart showing the kinds of extensions covered by supplementary orders in the U–1 series, and the forms or applications, if any, to be filed in connection with them.

Definition of Inventory. Paragraph (a) (11). The definition of inventory is modified, in order to emphasize that "fuel" is not to be included in the inventory controls of U–1. Also specifically excluded from inventory are water purification and treatment material (except equipment), and gas

chemical material. Such material is also excluded from the controls on purchasing by a provision in paragraph (f) (2). Schedule A has been changed to correspond with the new definition of inventory. The term "material incorporated in plant" means material physically incorporated in plant and ready for operation.

Part II

Assignment of preference ratings. A change has been made in the assignment of preference ratings in order to avoid the record-keeping that has been required by strict compliance with the former "split rating" provisions. The following rules should be observed in obtaining material (other than controlled materials) for U–1 purposes:

1. Use the preference rating AA–1 for:

(a) All material except that included in the "transmission and distribution" class of material.

(b) Material in the "transmission and distribution" class required to take care of an actual or imminent breakdown of facilities.

2. Use the preference rating AA–3 for all material in the "transmission and distribution" class except when the AA–1 rating is needed to assure prompt deliveries of material for repairs in this class. In the case of electric utilities, wood poles and cross arms are to be considered a part of transmission and distribution material.

It is made clear that material obtained with the AA–3 rating assigned by the order or by a specific assignment of preference rating such as on Form WPB–2774 may be used for AA–1 purposes. Conversely, non-controlled materials in inventory acquired by the use of the AA–1 rating may be used for purposes for which an AA–3 rating has been assigned whether assigned by U–1 or by a WPB–2774 approval. However, if it becomes necessary to replace such material in inventory, the AA–3 rating must be used to replace it, or, at the utility's option, the AA–3 rating may be used to replace an equivalent dollar value of non-controlled material in the same class.

Similarly, controlled material acquired with the use of the allotment symbol U–9 of Order U–1 may be used on a construction job for which a specific allotment of such controlled material has been made. If it is necessary to replace such controlled material, the specific allotment and allotment number that has been assigned for the controlled material for the construction job must be used for the replacement.

In effect, the order states that you may "borrow" material from U–1 inventory for construction jobs, but if the "borrowed" material or its equivalent is to be returned, use the preference rating or allotment that was assigned or allotted to the job in getting the material to pay back your "borrowing."

Use of certification. Paragraph (d). It is not required that the *exact* form of certification given in paragraph (d) be used.

It should be noted that *substantially* the form given must be used. For example, since the certification of Priorities Regulation 7 is substantially that of the certification of Order U–1, it may be used, or any other similar form of certification provided that the certification makes it clear that the material ordered is for uses under Order U–1.

Part III

1. *Paragraphs (e) and (f).* The restrictions on scheduling deliveries of former paragraph (f) (1) of Utilities Order U–1 have been retained with one important change. Formerly under Utilities Order U–1, a delivery of material from a producer's own excess inventory or from the excess inventory of another utility counted as a "scheduled delivery." This is no longer the case under the present order, thus, in effect, increasing the permissible quota of material which may be ordered.

In determining the dollar values of materials which have been scheduled for delivery, only the material ordered from prime suppliers such as jobbers, dealers, and manufacturers need be included. Utilities who find that their operations under U–1 are constrained by the limits of their quotas for scheduling deliveries should look for relief by obtaining the required material from the excess inventory of other utilities in preference to requesting a specific increase in their permissible quotas.

It should be particularly noted that the quotas for scheduled deliveries and the inventory bases of Order U–1 prior to this amendment need not be recalculated.

The following changes are optional as to the quotas for scheduled deliveries:

Water utilities may use as a quarterly quota in the "transmission and distribution" class either one-third of the dollar value of

material withdrawn during the last nine months of 1942, or 60% of the dollar value of material in that class withdrawn for maintenance, repair, and operating supplies in the corresponding quarter of 1940. This latter figure is readily available, since utilities were required to use it in connection with their operations under Order P–46.

All utilities may place their quotas for deliveries of "production plant" materials—(Class 1 of Schedule A) on an annual basis instead of on a quarterly basis. Additional requirements for material in this class brought about by increased plant output are recognized in the quotas set for Class 1 in Schedule B.

Delivery and inventory quotas now appear in Schedules B and C, instead of in the body of the order.

2. *Exception for utilities having a total inventory of $10,000 or less. Paragraph (f) (1).* The benefits of the order are applicable to all utilities, irrespective of size. It is recognized, however, that smaller utilities often have inadequate personnel for record-keeping and accounting. Therefore the requirements in this respect have been simplified for utilities having inventories totaling $10,000 or less excluding the dollar value of fuel, water and gas purification and treatment chemicals, and other materials specifically excluded from inventory by definition in paragraph (a) (11).

Such utilities no longer need keep their inventory records by classes, nor are they required to observe the restrictions in paragraph (e) on ordering materials so long as the receipt of the material that they order for U–1 uses does not cause their inventory to grow to a value in excess of the $10,000 limit, and so long as they observe the general standards for minimum inventories of paragraph (f) (1). Should this $10,000 limit be exceeded because of the receipt of material that has been ordered for U–1- purposes, they automatically become subject to the restrictions of paragraph (e) with respect to future purchases of materials. Some utilities, whose total inventory is less than, but close to the $10,000 limits, may find it desirable to continue their operations subject to the restrictions of paragraph (e).

Of course, utilities having inventories of $10,000 or less are subject to all of the provisions of the order except those contained in paragraph (e).

3. *Deletion of paragraph (f) (2) of former order.* It should be carefully noted that the inventory restrictions are applicable only to a control on *scheduling deliveries.* There is no restriction on *acceptance of delivery.* This will eliminate the confusion resulting from the delivery, by suppliers, of material at dates earlier or later than the dates specified by the utility for the delivery.

4. *Paragraph (g).* The reworded provisions on ordering "short items" of material in this paragraph should be noted. As the order is now written, a utility may purchase "short items" of material provided that purchases of the required item are planned, as to quantities and delivery dates, in such a way that the utility will have available no more than ninety days' estimated requirements of that item at any time. This does not preclude placing orders for deliveries of material more than ninety days in advance.

In estimating "requirements" under this part of the order the utility may include the minimum quantity of material required as a reserve to meet contingencies, such as a storm damage, or necessary to be held as spare parts for the repair or replacement of facilities whose failure would cause serious interruptions of service.

Part IV

This section describes the *qualitative* standards to be used in determining the propriety of proceeding with a maintenance or repair job, a replacement, or a minor plant addition.

Part V

This section contains a restatement of former paragraph (i) of U–1, with several notable changes:

(a) Sales by utilities are exempted from the provisions of Priorities Regulations 1 and 13 and only the provisions of paragraph (1) of U–1 are applicable.

(b) Sales of noncontrolled materials may be made to any person without a preference rating up to one hundred dollars total value per quarter.

(c) Sales of used equipment may be made to used equipment dealers without a preference rating. Former Schedule D of U–1 has accordingly been deleted.

(d) Utilities are no longer required to sell material from excess inventory if the value of the sale is less than $100.

Parts VI, VII and VIII

These sections show no substantive changes except that Schedule D (Schedule C of the former order), which lists the items of material the purchases of which must be cleared through Regional Utility Engineers, has been modified and shortened. Certain provisions of the former order relative to audits and reports are omitted since these are covered by the provision of Priorities Regulation 1.

No reports are required from utilities as to their operations under Order U–1 unless specifically requested by the War Production Board. Records of operations under U–1 should be kept in such a way as they will be readily available for inspection and audit.

Other Orders and Regulations of the War Production Board

Certain materials used by utilities are under the controls of special orders or regulations of the War Production Board; for example, photographic film and fire extinguishers are under a form of allocation or quasi-rationing, and the preference ratings assigned by U–1 are not valid to get them. Suppliers of such materials can inform utilities how to get a valid preference rating to obtain them. Other orders restrict the uses to which certain materials may be put or the amounts that may be held in inventory by any person. Two of these orders are mentioned below for your information.

1. *Limitation Order L–41.* This order, which regulates construction, establishes, for utilities, a limit for material and labor of $1,000 per year where the construction or renovation of buildings is involved. This limit is applicable to such work done on each building or on a group of related buildings that serve the same functional purpose. Applications to exceed these restrictions must be filed by utilities on Form WPB–2774. [*See* p. 1597 Dec., 1943 JOURNAL.]

2. *Limitation Order L–192.* This order restricts inventories of repair parts for construction machinery; it states that no person may order a repair part for construction machinery unless he expects to use it in the next thirty days. Suppliers of such repair parts can inform utilities of the provisions of this order applicable to utility purchases.

Amendments to Supplementary Orders in the U–1 Series

Supplementary orders in the U–1 series have been amended to conform with the revision of Order U–1. No important changes have been made except for the increase in the limit for overhead construction to $1,500, and for a change in Order U–1–h [*See* p. 1593 Dec., 1943 JOURNAL.], which now assigns the allotment symbol U–2 for controlled materials instead of the allotment symbol U–9.

Very truly yours,

J. A. KRUG, *Director*
Office of War Utilities

UTILITIES ORDER U–1 AS AMENDED JANUARY 22, 1944

Section 4500.1 *Utilities Order U–1* as heretofore amended is hereby amended to read as follows:

PART I—DEFINITIONS

(a) Definitions.

PART II—HOW TO OBTAIN MATERIAL

(b) Preference ratings.
(c) CMP allotment number.
(d) Certification.

PART III—RESTRICTIONS ON ORDERING MATERIAL

(e) Scheduling deliveries.
(f) Exceptions to paragraph (e).
(g) Short item deliveries.

PART IV—RESTRICTIONS ON USE OF MATERIAL

(h) Restrictions on use of material for maintenance and repair.

(i) Restrictions on use of material for minor plant additions.

(j) Restrictions on use of material for major plant additions.

PART V—SELLING MATERIAL

(k) Sales of material.
(l) Refusal to sell to other producers.

PART VI—INVENTORY REDISTRIBUTION

(m) Clearing orders through Regional Utility Engineers.

PART VII—GENERAL PROVISIONS

(n) Appeals.
(o) Records.
(p) Communications to War Production Board.
(q) Violations.
(r) Applicability of WPB regulations.
(s) Special delivery quota and inventory directions.

PART VIII—SCHEDULES

Schedule A, Material Classes.
Schedule B, Delivery Quotas.
Schedule C, Limits on Practical Working Minimum Inventory.
Schedule D, Items To Be Cleared Through Regional Utility Engineers.

§ 4500.10 *Utilities Order U–1.*

PART I—DEFINITIONS

(a) *Definitions.* (1) "Producer" means any individual, partnership, association, corporation, governmental corporation or agency, or any organized group of persons, whether incorporated or not, located in the United States, its territories, or possessions, supplying, or having facilities built for supplying, directly or indirectly for general use by the public, one or more of the following services:

(i) Electric power,
(ii) Gas, natural or manufactured, exclusive of the production and transmission of natural gas up to the point of its entry into gas transmission lines from field gathering lines,
(iii) Water, other than exclusively for irrigation purposes,
(iv) Central steam heating, or
(v) Any of the foregoing services but not for general use by the public, if a specific direction from the War Production Board entitles such person or agency to apply the ratings herein assigned. Application for such a specific direction should be made by letter to the War Production Board, Washington 25, D.C., Ref.: U–1.

(2) "Material" means any commodity, equipment, accessory, part, assembly or product of any kind.

(3) "Controlled materials" means controlled materials as defined in Schedule I of CMP Regulation 1.

(4) "Maintenance" means the upkeep of a producer's property and equipment in sound working condition. It does not include any plant addition.

(5) "Repair" means the restoration of a producer's property and equipment to sound working condition after wear and tear damage, destruction of parts, or the like have made such property or equipment unfit or unsafe for service. It does not include any plant addition.

(6) "Plant addition" means the construction or installation of new facilities or the replacement of existing facilities with facilities of greater capacity.

(7) "Minor plant addition" means a plant addition having a net material cost of not more than $1,500. No job or project may be subdivided to come within this limit.

(8) "Major plant addition" means a plant addition having a net material cost of more than $1,500.

(9) "Net material cost" means the cost of material incorporated in plant less the cost of material removed from plant, priced in accordance with the producer's regular accounting practice.

(10) "Operating supplies" means material, other than fuel, which is used or consumed in the course of a producer's operations, except in maintenance, repair, and plant additions.

(11) "Inventory" means all material in the producer's possession, without regard to its accounting classification, excluding, however, (i) material incorporated in plant, (ii) appliances and merchandising supplies, (iii) fuel, (iv) water purification and treatment material except equipment, (v) gas chemical material, (vi) material segregated for use in approved major plant additions, and (vii) scrap.

(12) "Class" means any one of those categories of material established as a basis for classification of inventory in Schedule A of this order.

PART II—HOW TO OBTAIN MATERIAL

(b) *Preference ratings.* (1) A preference rating of AA–1 is hereby assigned to orders to be placed by a producer for material (other than controlled materials) in

every class except the transmission and distribution class, for use in maintenance and repair, as operating supplies, and for minor plant additions.

(2) A preference rating of AA–1 is hereby assigned to orders to be placed by a producer for material (other than controlled materials(in the transmission and distribution class, for use in the repair of an actual or imminent breakdown.

(3) A preference rating of AA–3 is hereby assigned to orders to be placed by a producer for material (other than controlled materials) in the transmission and distribution class, for use in maintenance and repair, as operating supplies, and for minor plant additions, except where an AA–1 rating is assigned in paragraph (b) (2) above.

(4) Material obtained with the AA–1 rating may be used for purposes which are assigned lower ratings, but it may be replaced in inventory only by applying the lower rating to an equivalent dollar value of material in the same class. Material obtained with the AA–3 rating may be used for purposes which are assigned the AA–1 rating and may be replaced in inventory with either the AA–1 rating or an authorized AA–3 rating. The provisions of this paragraph (b) (4) supersede those of § 944.11, paragraph (a), of Priorities Regulation 1.

(5) Preference ratings for major plant additions may be obtained by filing an application on Form WPB–2774, unless ratings are assigned by a Supplementary U–1 Order such as U–1–h.

(c) *CMP allotment number.* (1) The abbreviated CMP allotment number U–9 is hereby assigned to orders to be placed by a producer for controlled materials for use in maintenance and repair, as operating supplies and for minor plant additions. Allotments of material for major plant additions may be obtained by filing an application on Form WPB–2774 unless an allotment number is assigned by a supplementary U–1 order such as U–1–h.

(2) An order for controlled materials for use in maintenance and repair, as operating supplies, and for minor plant additions bearing the abbreviated CMP allotment number U–9 and the certification required by paragraph (d) of this order shall be deemed an authorized controlled materials order. This abbreviated CMP allotment number shall constitute an "allotment number or symbol" for the purpose of CMP Regulation 3.

(d) *Certification.* The ratings assigned by subparagraphs (b) (1), (2) and (3) of this order and the abbreviated CMP allotment number U–9 may be applied by a producer only by the use of a certification in substantially the following form unless an order of the War Production Board affecting a particular item of material requires some other form of certification:

Preference Rating ....., Abbreviated CMP Allotment Number U–9. The undersigned producer certifies, subject to the penalties of Section 35 (A) of the United States Criminal Code, to the seller and to the War Production Board, that, to the best of his knowledge and belief, the undersigned is authorized under applicable War Production Board regulations or orders to place this delivery order, to receive, for utility uses under Utilities Order U–1, the material ordered, and to use the preference ratings or allotment numbers which the undersigned has placed on this order.

The certifications set forth in Priorities Regulation 3 and CMP Regulations 1 and 5 may not be used but the standard form of certification provided in Priorities Regulation 7 is permissible if the producer adds a statement saying that material ordered is for utility uses under Utilities Order U–1.

Part III—Restrictions on Ordering Material

(e) *Scheduling deliveries.* Except as permitted by paragraphs (f) and (g) below, no producer shall schedule for delivery to it in any calendar quarter any material to be used for maintenance and repair, as operating supplies, or for minor plant additions, unless both of the following conditions are satisfied:

(1) The dollar value of material to be scheduled for delivery together with the dollar value of all material in the same class which has been scheduled for delivery for these uses in the same calendar quarter, does not exceed the quota established in Schedule B, and

(2) The producer does not have reason to believe that its inventory of material in the same class is or will, by virtue of its acceptance of the delivery when made, become in excess of a practical working minimum. A practical working minimum inventory is that amount of material which a

producer, exercising prudent operating judgment, considers the smallest quantity of material it can hold and render war-time service at minimum standards. It may be less than the values established in Schedule C, but it shall in no case exceed them.

(f) *Exceptions to paragraph* (e). (1) The restrictions to paragraph (e) do not apply to a producer so long as its inventory does not exceed $10,000 in value, except that such a producer must restrict its inventory to that amount of material which, in the exercise of prudent operating judgment, it considers the smallest quantity it can hold and render war-time service at minimum standards. A producer engaged in furnishing more than one of the services named in paragraph (a) (1) may consider its inventory for each service separately for the purposes of this paragraph.

(2) The restrictions of paragraph (e) do not apply to material excepted from inventory by the definition in paragraph (a) (11).

(3) If a producer sells material to another producer from its practical working minimum inventory for the repair of an actual breakdown of facilities or equipment it may schedule additional deliveries in the affected classes to the extent necessary to replace the material sold.

(4) If a producer's property has been damaged by acts of the public enemy, sabotage, explosion, fire, flood, storm, or similar contingencies, it may schedule deliveries to the extent necessary to repair the damage. Deliveries scheduled under this exception which are in excess of the producer's quota must be reported immediately to the War Production Board by letter, with a statement of the reasons why the excess deliveries were necessary.

(5) The War Production Board may from time to time establish specific delivery quotas and limits for permissible inventory for individual producers, modifying the provisions of Schedules B and C.

(6) The restrictions of paragraph (e) (1) on the dollar value of materials which a producer may schedule for delivery do not apply to material scheduled for delivery from the producer's own excess inventory, or from the excess inventory of another producer.

(g) *Short item deliveries.* Even though it cannot schedule deliveries without exceeding the limits of paragraph (e) (2), a producer may schedule for delivery material which it will require for use in maintenance and repair, as operating supplies, and for minor plant additions during the ninety-day period following the date it expects to receive such material, so long as all of the following conditions are satisfied:

(1) The producer's inventory of the required material, together with material already scheduled for delivery, will be insufficient to meet requirements during such ninety-day period.

(2) All material in all classes of inventory in excess of a practical working minimum is (i) continuously recorded as excess on records kept by the producer for that purpose, (ii) continuously held for sale to financially responsible persons and agencies authorized (under applicable regulations issued by the War Production Board) to accept delivery thereof; and (iii) reported to the War Production Board, when requested by the War Production Board, on Form WPB–2641, to the extent required by such form, or in such other manner as the War Production Board may prescribe, subject to the approval of the Bureau of the Budget in accordance with the Federal Reports Act of 1942.

Part IV—Restrictions On Use of Material

(h) *Restrictions on use of material for maintenance and repair.* A job which can be classed as maintenance or repair, as those terms are defined in paragraphs (a) (4) and (5), may be done without regard to the dollar value of the material required when the following standards are met:

(1) The job must be necessary to maintain or restore service at minimum service standards or to prevent damage to facilities from serious overload, deterioration, storm, flood, climate, soil conditions, or similar contingencies.

(2) Design must emphasize economy of manpower and material as well as the substitution of the more plentiful for scarce material.

(3) No facility or part which is serviceable in its existing installation may be replaced except to avoid an imminent breakdown.

(i) *Restrictions on use of material for minor plant additions.* A job which is a plant addition, as defined in paragraph (a) (6), rather than maintenance and repair, may be done without special permission from the War Production Board, if it is a

"minor plant addition"; that is, if its net material cost does not exceed $1,500. Paragraph (a) (9) explains what is meant by net material cost. However, all minor plant additions are subject to the following restrictions:

(1) No facility or part which is serviceable in its existing installation may be replaced except to avoid an imminent breakdown.

(2) Design must emphasize economy of manpower and material as well as the substitution of the more plentiful for scarce material.

(3) New facilities must be necessary for rendering service at minimum standards.

(4) No extension of a line to consumer premises may be made or connected by a producer unless it is authorized by a Supplementary U–1 order or by the approval of an application filed on Form WPB–2774. In an emergency approval may be obtained by telephone or telegraph. Confirmation must be obtained, however, by the submission of an application on Form WPB–2774.

(j) *Restrictions on use of material for major plant additions.* No material may be used for a major plant addition unless the job has been authorized by a Supplementary U–1 Order, such as U–1–h, or by the approval of an application filed on Form WPB–2774. In an emergency approval may be obtained by telephone or telegraph. Confirmation must be obtained, however, by the submission of an application on Form WPB–2774.

PART V—SELLING MATERIAL

(k) *Sales of material.* A producer may sell material which is in its practical working minimum or excess inventory or which it acquired for major plant additions only in accordance with the following rules:

(1) It may be sold to any person to fill an order rated AA–5 or higher unless it is controlled materials.

(2) It may be sold without a preference rating to any person if the aggregate dollar value of all sales by the producer to that person during the current calendar quarter does not exceed $100, and if the material is not controlled materials.

(3) It may be sold to fill an authorized controlled materials order if it is controlled materials.

(4) It may be sold pursuant to a specific written direction from the War Production Board to the seller or to the purchaser.

(5) It may be sold without a preference rating or allotment number to a person who produces, or to the person from whom the producer purchased, the material in its present form.

(6) It may be sold without a preference rating to a scrap dealer as scrap.

(7) It may be sold without a preference rating to a used equipment dealer, if it is used equipment.

(8) It may be sold without a preference rating or allotment number to the Army, Navy, Maritime Commission, or a public housing authority for the repair of an actual or threatened breakdown of their electric, gas, water or central steam heating facilities.

(9) The restrictions on sales in Priorities Regulations 1 and 13 do not apply to sales by producers made under this paragraph.

(10) The provisions of Limitation Orders L–94 and L–102 relating to transfers of electric generating equipment, L–196 relating to transfers of used construction machinery, and Utilities Order U–7 relating to transfers of gas equipment must be observed.

(l) *Refusal to sell to other producers.* Any producer may, by specific direction from the War Production Board, be prohibited from applying or extending preference ratings assigned by this order or by any other certificate or order, upon a determination by the War Production Board, that such producer has willfully refused to sell (after receiving a bona fide offer to purchase at not less than maximum prices established by regulations of the Office of Price Administration, made by any financially responsible producer who is authorized —under applicable regulations—to accept delivery of the material specified in such offer) the following material:

(1) Material which is in inventory in excess of a practical working minimum, unless the value of the material requested is less than $100, and

(2) Material which is included in practical working minimum inventory when such material is required by another producer for the repair of an actual breakdown of facilities or equipment.

PART VI—INVENTORY REDISTRIBUTION

(m) *Placing orders through Regional Utility Engineers.* Except in an emergency no producer may transmit to any supplier other than another producer an order totaling $100 or more for the delivery of any item of material (including material for major plant additions) listed in Schedule D of this order without first obtaining a statement from the Regional Utility Engineer in his region or from the Office of War Utilities in Washington, that such material is not reasonably available in the excess inventory of another producer. This statement shall be secured by filing an inquiry, in duplicate, with the regional utility engineer, in letter form or by using the producer's own price inquiry forms, stating (1) the quantity of each item required and (2) a description of the item. An oral or telephonic statement will be sufficient for the purposes of this paragraph, provided that written confirmation is promptly obtained.

PART VII—GENERAL PROVISIONS

(n) *Appeals.* Relief from any of the restrictions of this order may be requested by filing a letter with the War Production Board, Office of War Utilities, Washington, D.C., Ref.: U-1, stating the reasons why relief is necessary. If the relief requested involves a request to make a plant addition, the request should be filed on Form WPB-2774.

(o) *Records.* In addition to the records required to be kept under Priorities Regulation 1, each producer who applies the preference ratings or allotment number hereby assigned shall maintain a continuing record of inventory and of segregated material in his possession.

(p) *Communications to War Production Board.* All reports required to be filed hereunder and all communications concerning this order, shall, unless otherwise directed, be addressed to: Office of War Utilities, War Production Board, Washington 25, D.C., Ref.: U-1.

(q) *Violations.* Any person who wilfully violates any provision of this order, or who, in connection with this order, wilfully conceals a material fact or furnishes false information to any department or agency of the United States, is guilty of a crime, and upon conviction may be punished by fine or imprisonment. In addition, any such person may be prohibited from making or obtaining further deliveries of, or from processing or using, material under priorities control and may be deprived of priorities assistance.

(r) *Applicability of WPB regulations.* This order and all transactions affected hereby are subject to all applicable regulations of the War Production Board, as amended from time to time, unless there is a conflict between this order and such regulations, in which case this order shall govern, if it specifically so provides. No producer is, however, subject to the restrictions of CMP Regulation 5 nor may any producer in any way use the preference ratings therein assigned.

(s) *Special delivery quota and inventory directions.* Nothing in this order is intended to supersede any special quota for scheduled deliveries or any special inventory base established by a specific direction from the War Production Board to a named producer. All such directions shall remain in effect unless modified by a further specific direction to the producer affected.

Issued this 22d day of January 1944.

WAR PRODUCTION BOARD,
By J. JOSEPH WHELAN,
Recording Secretary.

PART VIII—SCHEDULES

SCHEDULE A

MATERIAL CLASSES

Material in the inventory of any producer which has an inventory, as defined in paragraph (a) (11), in excess of $10,000 shall be carried on the producer's own records and reported to the War Production Board as may be required, classified as follows:

WATER PRODUCERS

Class 1—Material for sources of supply, water treatment plants, reservoirs, elevated and pressure tanks, pumping and booster stations, including related pipe, valves, valve parts, and fittings.

Class 2—Meters.

Class 3—Transmission and distribution material (excluding meters), such as cast iron, steel, and wrought iron pipe, copper and brass pipe and tubing, lead pipe, pipe fittings, valve and valve parts, hydrants, parts for meters and hydrants, and other transmission and distribution material and supplies

except pipe, valves, valve parts, and fittings included in Class 1 above.

Class 4—Other material and supplies.

GAS PRODUCERS

Class 1—Production and pumping station material.

Class 2—Meters and house regulators.

Class 3—Transmission and distribution material (excluding meters and house regulators), such as cast iron, steel and wrought iron pipe, copper and brass pipe and tubing, pipe fittings, valves, and valve parts, governors and regulators, parts for meters, regulators, and governors, other transmission and distribution material and supplies.

Class 4—Other material and supplies.

ELECTRIC POWER PRODUCERS

Class 1—Generating station material such as electrical equipment, parts, and materials, and other material and supplies.

Class 2—Switching and substation material, such as power transformers, other station equipment, parts, and material, and other material and supplies.

Class 3—Wire, cable, and bus bar, such as bare copper and aluminum, weatherproof copper, underground cable, aluminum and copper shapes.

Class 4—Wood poles and cross arms.

Class 5—Meters.

Class 6—Other transmission and distribution material, such as iron and steel poles, towers, and parts, line hardware—overhead and underground, distribution transformers, meter and transformer parts, and other line material and equipment (including insulators, lightning arrestors, etc.).

Class 7—Other material and supplies.

CENTRAL STEAM HEATING PRODUCERS

Class 1—Production plant material.

Class 2—Transmission and distribution material and other material and supplies.

SCHEDULE B

DELIVERY QUOTAS

To compute the delivery quota (not applicable to producers having inventories of $10,000 or less because they are exempted by the provisions of paragraph (f)), in any class of material for the purposes of paragraph (e) (1), first determine the "base quota" for that class. The base quota in any class is the dollar value of withdrawals in that class made during the last nine months of 1942 for use as "maintenance, repair, and operating supplies," as those terms were defined in Utilities Order U–1 as amended September 24, 1943.[1] *Second, use this base quota to determine the actual delivery quota for the class of material in question in accordance with the following:*

WATER PRODUCERS [2]

Class 1—A quota of four-thirds of the base quota, increased proportionately to the increase in system output in the year preceding the current year over output in 1940. This quota may be divided among the four calendar quarters as the producer requires.

Class 2—A quarterly quota of one-third of the base quota.

Class 3—A quarterly quota of one-third of the base quota or, at the producer's option, a quarterly quota equal to 60 per cent of the dollar value of material in this class withdrawn during the corresponding quarter of 1940 for use in "maintenance, repair, and operating supplies," as those terms were de-

[1] These definitions are reprinted here for convenience in reference; please note that they differ from definitions used in the current order:

"Maintenance" means the upkeep of a producer's property and equipment in sound working condition.

"Repair" means the restoration of a producer's property and equipment to sound working condition after wear and tear, damage, destruction of parts, or the like, have made such property or equipment unfit or unsafe for service.

"Operating supplies" means (1) material which is essential to the operation of any of the industries or services specified above and which is generally carried in a producer's inventory and charged to operating expense accounts, and (2) material for an addition to or an expansion of property or equipment (including a minor extension of lines), provided that such addition or expansion shall not include any work order, job, or project in which the cost of material shall exceed $1500 in the case of underground construction and $500 in the case of other construction, and provided that no single construction project shall be subdivided into parts in order to come below these limits.

[2] See Schedule A for complete identification of classes.

fined in Utilities Order U–1 as amended September 24, 1943.[1]

Class 4—A quarterly quota of one-third of the base quota.

GAS PRODUCERS [2]

Class 1—A quota of four-thirds of the base quota, increased proportionately to the increase in system output in the year preceding the current year over output in 1940. This quota may be divided among the four calendar quarters as the producer requires.

Classes 2, 3 and 4—A quarterly quota of one-third of the base quota.

ELECTRIC POWER PRODUCERS [2]

Class 1—A quota of four-thirds of the base quota, increased proportionately to the increase in system output in the year preceding the current year over output in 1940. This quota may be divided among the four calendar quarters as the producer requires.

Classes 2, 3, 4, 5, 6 and 7—A quarterly quota of one-third of the base quota.

CENTRAL STEAM HEATING PRODUCERS [2]

Class 1—A quota of four-thirds of the base quota, increased proportionately to the increase in system output in the year preceding the current year over output in 1940. This quota may be divided among the four calendar quarters as the producer requires.

Class 2—A quarterly quota of one-third of the base quota.

SCHEDULE C

LIMITS ON PRACTICAL WORKING MINIMUM INVENTORY

Paragraph (e) (2) provides that a practical working minimum inventory (except for producers having a total inventory of $10,000 or less, who are exempted by paragraph (f)) may in no case exceed the following dollar values:

WATER PRODUCERS [2]

Class 1—The dollar value of items of material of this class in inventory on the most recent date in 1940 on which the producer's inventory was taken, increased proportionately to the increase in system output in the twelve-month period preceding the current quarter over output in 1940.

Class 2—Four-thirds of the dollar value of authorized withdrawals in this class made during the last nine months of 1942 for use as "maintenance, repair, and operating supplies," as those terms were defined in Utilities Order U–1 as amended September 24, 1943.[1]

Class 3—Sixty per cent of the dollar value of material in this class in inventory on the most recent date in 1940 on which the producer's inventory was taken.

Class 4—Two-thirds of the dollar value of authorized withdrawals in this class made during the last nine months of 1942 for use as "maintenance, repair, and operating supplies," as those terms were defined in Utilities Order U–1 as amended September 24, 1943.[1]

GAS PRODUCERS [2]

Class 1—The dollar value of items of material of this class in inventory on the most recent date in 1940 on which the producer's inventory was taken, increased proportionately to the increase in system output in the twelve-month period preceding the current quarter over output in 1940.

Classes 2 and 3—Four-thirds of the dollar value of withdrawals in this class made during the last nine months of 1942 for use as "maintenance, repair, and operating supplies," as those terms were defined in Utilities Order U–1 as amended September 24, 1943.[1]

Class 4—Two-thirds of the dollar value of withdrawals in this class made during the last nine months of 1942 for use as "maintenance, repair, and operating supplies," as those terms were defined in Utilities Order U–1 as amended September 24, 1943.[1]

ELECTRIC POWER PRODUCERS [2]

Class 1—The dollar value of items of material of this class in inventory on the most recent date in 1940 on which the producer's inventory was taken, increased proportionately to the increase in system output in the twelve-month period preceding the current quarter over output in 1940.

Class 2—The dollar value of items of material of this class in inventory on the most recent date in 1940 on which the producer's inventory was taken.

Classes 3 and 4—Four-thirds of the dollar value of withdrawals in this class made during the last nine months of 1942 for use as "maintenance, repair, and operating supplies," as those terms were defined in Utilities Order U–1 as amended September 24, 1943.[1]

Class 5—Fifty meters at each operating headquarters plus one and three-quarters per cent of the meters installed in plant on the first day of the preceding calendar quarter.

Class 6—Four-thirds of the dollar value of withdrawals in this class made during the last nine months of 1942 for use as "maintenance, repair, and operating supplies," as those terms were defined in Utilities Order U–1 as amended September 24, 1943.[1]

Class 7—Two-thirds of the dollar value of withdrawals in this class made during the last nine months of 1942 for use as "maintenance, repair, and operating supplies," as those terms were defined in Utilities Order U–1 as amended September 24, 1943.[1]

CENTRAL STEAM HEATING PRODUCERS [2]

Class 1—The dollar value of items of material of this class in inventory on the most recent date in 1940 on which the producer's inventory was taken, increased proportionately to the increase in system output in the twelve-month period preceding the current quarter over output in 1940.

Class 2—Two-thirds of the dollar value of withdrawals in this class made during the last nine months of 1942 for use as "maintenance, repair, and operating supplies," as those terms were defined in Utilities Order U–1 as amended September 24, 1943.[1]

SCHEDULE D—ITEMS TO BE CLEARED THROUGH REGIONAL UTILITY ENGINEERS

ITEMS TO BE USED BY WATER PRODUCERS

1. Copper and brass tubing.
2. Bronze valves, smaller than 2 inches, except corporation cocks and curb stops.
3. Valves, cast iron and steel, 2 inches and larger.
4. Consumer meters.
5. Pumps.

ITEMS TO BE USED BY GAS PRODUCERS

1. Steel and wrought iron pipe.
2. Mechanical pipe couplings larger than 4 inches.
3. Copper and brass pipe and tubing.
4. District regulators and governors.
5. Meters, consumers.
6. Bronze valves smaller than 2 inches, except corporation cocks and curb stops.
7. Cast iron and steel valves, 2 inches and larger.
8. Condensers (coolers).
9. Exhausters.
10. Boosters.
11. Compressors.
12. Pumps.
13. Blowers.
14. Station meters.

ITEMS TO BE USED BY ELECTRIC POWER PRODUCERS

1. Wire, bare and weatherproof (copper, aluminum, copper or aluminum composite), having conductivity greater than #10 AWG copper conductor.
2. Cable.
3. Bus bar shapes.
4. Power transformers.
5. Distribution transformers.
6. Watthour meters, domestic.
7. Oil circuit breakers.
8. Regulators (feeder voltage).
9. Current transformers.
10. Potential transformers.
11. Disconnecting switches.

SUPPLEMENTARY ORDERS IN THE U–1 SERIES

The following supplementary orders in the U–1 series are amended under date of January 22, 1944, but principal change in each case was to set the dollar expenditure for total cost of material under the terms of the sub order at $1500, without reference to whether the work is done underground or above ground.

EXPLANATORY CHART

Type of consumer	Applicable supplementary order	Value limits for material	Form to be filed*	Principal limitations (dollar limits are always applicable)
Armed services, etc.	U–1–a	$1,500	None	Dollar value limits.
Agricultural	U–1–c†	$1,500	None	100 feet of extension per animal unit. Certification by County Agricultural Conservation Committee.
Domestic	U–1–d	$1,500	WPB 3348	Where construction by or for consumer is involved and builder files application under L–41. Housing Utilities Standards. Form 3348 is filed with builder's application.
	U–1–h	$1,500–$5,000		
	U–1–f	$1,500	None	Where no application is being filed under L–41. Utilities Construction Standards.
Commercial and Industrial	U–1–d	$1,500	WPB 3348	Where construction by or for consumer is involved and builder files application under L–41. Form 3348 is filed with builder's application.
	U–1–h	$1,500–$5,000		
	U–1–f	$1,500	None	Where no application is filed by consumer under L–41. Consumer listed on Schedules I or II of CMP Regulation 5 or is listed in U–1–f or U–1–h.
	U–1–h	$1,500–$5,000	None	
Victory gardens	U–1–e†	None	None	250 feet of pipe.
Temporary	U–1–g	$1,500	None	Ninety days' use of service.

* If proposed extension exceeds the limitations of the applicable supplementary order, utility may request authority to proceed with the construction by filing Form WPB 2774 with the Office of War Utilities, War Production Board, Washington, D. C.

† Order U-1-c does not relate to public water supply. Order U-1-e will be found on p. 150 this Journal.

SUPPLEMENTARY UTILITIES ORDER U–1–a, AS AMENDED JAN. 22, 1944

§ 4500.2 *Supplementary Utilities Order U–1–a*—(a) *Permission to build certain extensions.* In accordance with the provisions of paragraph (i) of Utilities Order U–1, extensions of electric, water, gas, and central steam heating facilities may be made or connected by producers to serve facilities of the Army, Navy, Maritime Commission, War Shipping Administration, or Civil Aeronautics Authority, upon the direct order of such agencies when all of the following conditions are satisfied:

(1) The total cost of material for each extension, exclusive of any part built by or for the consumer, does not exceed $1500. No job or project may be subdivided to come within these limits.

(2) No other producer can render the same service with lesser amounts of critical material.

(3) The extension does not duplicate an adequate service already installed or constitute a stand-by service.

(b) *Other orders.* This order does not constitute a release, in the case of gas producers or consumers, from the restrictions of Utilities Order U–7 or Limitation Order L–174.

Issued this 22d day of January 1944.

WAR PRODUCTION BOARD,
By J. JOSEPH WHELAN,
Recording Secretary.

SUPPLEMENTARY UTILITIES ORDER U–1–d, AS AMENDED JAN. 22, 1944

§ 4500.5 *Supplementary Utilities Order U–1–d.* In accordance with the provisions of paragraph (i) of Utilities Order U–1, extensions of electric, water, gas, and central steam heating facilities may be made or connected by producers to serve premises, the construction or remodeling of which is authorized under Conservation Order L–41 by the issuance of a specific direction, order, certificate, or other authorization for construction, when all of the following conditions are satisfied:

(a) *Industrial or commercial consumers.* The extension is designed to use the smallest sizes and quantities of equipment, conductor, and pipe required to furnish service at minimum standards.

(b) *Domestic consumers.* (1) The extension, including any part built by or for the consumer, can be built within the limits established by the Housing Utilities Standards issued by the War Production Board.

(2) In the case of gas or electric facilities primarily to serve cooking appliances, (i) the dwelling proposed for connection is not equipped with a range of any kind; and (ii) complete facilities to a cooking range location are not installed for serving either a gas range or an electric range, except that extensions to serve a gas or electric range which the consumer has used in a dwelling which he previously occupied may be made even though facilities for serving another type of range are already installed.

(c) *All consumers.* (1) The total cost of material for each extension, exclusive of any part built by or for the consumer, does not exceed $1500. No job or project may be subdivided to come within these limits.

(2) No other producer can render the same service with lesser amounts of critical material.

(3) The extension does not duplicate an adequate service already installed or constitute a standby service.

(4) The producer has completed Form WPB–3348 for filing with the builder's application under L–41.

(d) *Other orders.* This order does not constitute a release, in the case of gas producers or consumers, from the restrictions of Utilities Order U–7 or Limitation Order L–174.

Issued this 22d day of January 1944.

WAR PRODUCTION BOARD,
By J. JOSEPH WHELAN,
Recording Secretary.

SUPPLEMENTARY UTILITIES ORDER U–1–f, AS AMENDED JAN. 22, 1944

§ 4500.7 *Supplementary Utilities Order U–1–f*—(a) *Definitions.* For the purposes of this supplementary order:

(1) "Domestic consumer" means a prospective consumer who is requesting an extension of service to a building used exclusively for dwelling purposes.

(2) "Industrial consumer" means a prospective consumer who is requesting an extension of service to a building used in whole or in part for the manufacture, processing or assembly of products or materials.

(3) "Commercial consumer" means a prospective consumer not classified in this order as "domestic" or " industrial."

(b) *Permission to build certain extensions.* In accordance with the provisions of paragraph (i) of Utilities Order U–1, extensions of electric, water, gas, and central steam heating facilities may be made or connected by producers when all of the following conditions are satisfied:

(1) Where construction or remodeling by the consumer is involved, no specific direction, order, certificate or other authorization for construction has been issued by the War Production Board to authorize such construction or remodeling. If such authorization has been issued, the construction of utility facilities is governed by Supplementary Utilities Order U–1–d or U–1–h.

(2) In the case of gas or electric facilities primarily to serve cooking appliances, (i) the dwelling proposed for connection is not equipped with a range of any kind, and (ii) complete facilities to a cooking range location are not installed for serving either a gas range or an electric range, except that extensions to serve a gas or electric range which the consumer has used in a dwelling which he previously occupied may be made

even though facilities for serving another type of range are already installed.

(3) In the case of facilities to serve industrial or commercial consumers, the consumer (i) is engaged in the manufacture of a product or in the conduct of a business or activity listed in Schedules I or II of CMP Regulation 5, as amended; or (ii) is an electric, water, gas, steam heat, telephone or telegraph utility; or (iii) is engaged in the petroleum industry, except in retail marketing, as those terms are defined in Preference Rating Order P-98-b; or (iv) is engaged in the business of mining, or of burning refractories, and has been assigned a serial number under Preference Rating Order P-56; or (v) is engaged in the business of radio communication or radio broadcasting; or (vi) is a school, church, or hospital.

(4) Extensions including any part built by or for the consumer, can be built within the limits of the Utilities Construction Standards, shown in Schedule I of this order, including any part built by or for the consumer.

(5) The total cost of material for each extension, exclusive of any part built by or for the consumer, does not exceed $1500. No job or project may be subdivided to come within these limits.

(6) No other producer can render the same service with lesser amounts of critical material.

(7) The extension does not duplicate an adequate service already installed or constitute a stand-by service.

(c) *Other orders.* This order does not constitute a release, in the case of gas producers or consumers, from the restrictions of Utilities Order U-7 or Limitation Order L-174.

Issued this 22d day of January 1944.

WAR PRODUCTION BOARD,
By J. JOSEPH WHELAN,
Recording Secretary.

SCHEDULE I—UTILITIES CONSTRUCTION STANDARDS

The material used in extensions permitted by Supplementary Utilities Order U-1-f must conform to the limitations set out in this Schedule I and must not exceed, in dollar value, the limits of paragraph (b) (5).

A. PERMITTED TYPES OF CONDUCTOR AND PIPE

I. *Domestic extensions.* a. *Electric conductor for primary, secondary, and service drop:*

(1) Any type or size of conductor having conductivity equal to or less than that of No. 6 AWG copper, or

(2) Any type or size of conductor which can be obtained from the excess inventory of any producer.

(b) *Pipe:*

(1) For mains over 4" in diameter (i) cast iron or non-metallic pipe or (ii) steel pipe in cases where installation conditions, high working pressures, or danger of breakage or leakage make the use of a substitute material impracticable or dangerous.

(2) For mains 4" in diameter and smaller and all service connections, any type of pipe.

II. *Commercial and industrial extensions.* No limitation, except as shown below in B, II.

B. PERMITTED QUANTITIES OF CONDUCTOR AND METALLIC PIPE

I. *Domestic extensions.* a. *For electric service,* not more than 1000 conductor feet, including primary, secondary, and service drop.

b. *For gas or central steam heating service,* not more than (1) 400 pounds of steel pipe or 1800 pounds of cast iron pipe, or (2) a combination involving not more than 400 pounds of steel pipe and not more than 1800 pounds of cast iron pipe, this quantity of cast iron pipe to be diminished by twice the weight of steel pipe used.

c. *For water extensions,* not more than (1) 400 pounds of steel pipe or 1800 pounds of cast iron pipe or 1000 pounds of lead or lead alloy pipe, or (2) one of the following combinations:

(1) 400 pounds of steel pipe and not more than 1800 pounds of cast iron pipe, this quantity of cast iron pipe to be diminished by twice the weight of steel pipe used. In addition, a lead goose-neck is permitted.

(2) 1000 pounds of lead or lead alloy pipe and not more than 1800 pounds of cast iron pipe, this quantity of cast iron pipe to be diminished by the weight of any lead or lead alloy pipe used.

(3) 400 pounds of steel pipe and not more than 1000 pounds of lead or lead alloy pipe, this quantity of lead or lead alloy pipe to be

diminished by twice the weight of steel pipe used.

II. *Commercial and industrial extensions.* The smallest sizes and quantities of equipment, conductor and pipe required to furnish service at minimum standards.

C. PERMITTED QUANTITIES OF NON-METALLIC PIPE

Non-metallic pipe of a length not greater than that length which would be installed if cast iron pipe were used as permitted in B above.

SUPPLEMENTARY UTILITIES ORDER U–1–g, AS AMENDED JAN. 22, 1944

§4500.8 *Supplementary Utilities Order U–1–g.* In accordance with the provisions of paragraph (i) of Utilities Order U–1, temporary extensions of electric, water, gas, and central steam heating facilities may be made or connected by producers to serve temporary business, civic or recreational facilities when all of the following conditions are satisfied:

(a) The cost of material for such utility extensions is less than $1,500,

(b) Such extensions will be dismantled at the expiration of ninety days from date of installation and all material salvaged and returned to inventory,

(c) No other producer can render temporary service with less critical material.

Issued this 22d day of January 1944.

WAR PRODUCTION BOARD,

By J. JOSEPH WHELAN,

Recording Secretary.

SUPPLEMENTARY UTILITIES ORDER U–1–h, AS AMENDED JAN. 22, 1944

§ 4500.9 *Supplementary Utilities Order U–1–h*—(a) *Permission to build certain extensions.* In accordance with the provisions of paragraph (j) of Utilities Order U–1, extensions of electric, gas, water, and central steam heat facilities may be made or connected by a producer, subject to the restrictions of paragraph (b) below, to serve the following types of consumer premises:

(1) Premises which are being built or remodeled under authority of a specific authorization issued pursuant to Conservation Order L–41.

(2) Premises which will be occupied exclusively by the Army, Navy, Maritime Commission, War Shipping Administration or Civil Aeronautics Authority.

(3) Premises of an industrial or commercial consumer,

(i) In cases where the extension or enlargement of utilities facilities is necessary for the production of one of the products or the supply of one of the services listed in Schedules I and II of CMP Regulation 5 or

(ii) In cases where the consumer is an electric, water, gas, steam heat, telephone, or telegraph utility; or is engaged in the petroleum industry, except in retail marketing, as these terms are defined in Preference Rating Order P–96–b; or is engaged in the business of mining, or of burning refractories, and has been assigned a serial number under Preference Rating Order P–56; or is engaged in the business of radio communication or radio broadcasting; or is a school, church, or hospital.

(b) *Restrictions on construction.* Extensions of the type permitted by paragraph (a) of this order may be built only if all of the following conditions are satisfied:

(1) The total cost of material for any such extension, exclusive of any part built by or for the consumer, exceeds $1,500 but does not exceed $5,000. No job or project may be subdivided to come within these limits.

(2) The extension does not duplicate an adequate service already installed or constitute a stand-by service.

(3) No other producer can render the same service with lesser amounts of critical material.

(4) In the case of extensions to buildings which are to be used exclusively for dwelling purposes the extension (including service drop or service pipe and any portion built

by or for the consumer) can be built within the limits established by the Housing Utilities Standards issued by the War Production Board.

(5) In the case of extensions to premises which are to be built or remodeled under authority of a specific authorization applied for pursuant to Conservation Order L–41, the producer has completed Form WPB–3348, and delivered it to the builder for attachment to the builder's application for L–41 approval.

(c) *Assignment of preference rating and CMP allotment number.* (1) The preference rating AA–3 is hereby assigned to orders for material other than controlled material, and the abbreviated CMP allotment number U–2 is hereby assigned to orders for controlled material, to be placed by a producer for use in the construction of extensions of facilities authorized by this supplementary order or to replace in inventory material so used.

(2) The preference rating and allotment number assigned above may be applied by a producer by using the certification provided in CMP Regulation 7.

(3) An order for controlled material bearing the CMP allotment number U–2 shall be deemed an authorized controlled materials order. This allotment number shall constitute an "allotment number or symbol" for the purpose of CMP Regulation 3.

(d) *Acquisition of material.* The acquisition of material for extensions of facilities authorized by this supplementary order is subject to the following restrictions:

(1) It may be ordered only to the extent that it is not available in the producer's inventory in excess of a practical working minimum.

(2) If taken from such excess inventory it may not be replaced.

(3) If taken from practical working minimum inventory it may be replaced therein only in accordance with paragraph (b) of Utilities Order U–1.

(4) It may not be ordered until either

(i) The producer has been advised that the builder of the structure to be served has received L–41 approval, or

(ii) The producer has been advised by such builder that L–41 approval is not required and has received a written request from such builder to supply the utility service.

(e) *Other orders.* This order does not constitute a release, in the case of gas producers or consumers, from the restrictions of Utilities Order U–7 or Limitation Order L–174.

Issued this 22d day of January 1944.

WAR PRODUCTION BOARD,
By J. JOSEPH WHELAN,
Recording Secretary.

Copper Limitation Order Amended

SUPPLEMENTARY Order M–9–c–4 has been amended, according to information released on January 24, 1944, through the OWI (WPB–4865).

Frozen inventories of copper and copper base alloy pipe, tubing and fittings in the hands of utilities [*see* p. 542 April, 1943 JOURNAL] were freed January 24, 1944, for use in underground gas and water supply and distribution installations outside buildings.

This action was effected by amending Supplementary Conservation Order M–9–c–4 and was made possible by the better supply-demand situation of copper ingot, which makes purchase of completely fabricated material for remelt no longer necessary. In the past, finished products were remelted to furnish ingots for items more needed in the war effort.

The amended order makes available the frozen stocks of water and gas utilities as of January 1.

WPB SUPPLEMENTARY ORDER M-9-c-4 AS AMENDED JAN. 24, 1944

(b) *Restrictions on installations of certain copper products*—(2) *Exceptions.* Notwithstanding the prohibitions against installation of paragraph (b) (1):

(iii) Copper or copper base alloy pipe, tubing or fittings in the inventory of a water or gas utility on January 1, 1944, may be connected to a water supply of water distribution system or any underground gas supply or gas distribution system, if the pipe, tubing or fittings are to be used both underground and outside of a building. (GPO—War Board 9508.)

Money Talks for Conservation of Water in Louisville, Ky.

AN effective technique has been inaugurated by the Louisville Water Company, to promote consumer leak surveys, to stop the drip and *use water usefully*. Hold on to your hats water operators! The program includes a reduced rate to consumers who stop leaks in their water fixtures and services.

Large advertisements appeared in the daily newspapers of Louisville, in January of this year, illustrating very graphically the cost of a slight almost imperceptible leak, and increasingly larger leaks. The savings ranged from a humble dime per month to $212 per month on the customers' water bills. It had a telling and electrical effect in results!

Here are excerpts from the advertisement, which helped to tell the story of water conservation:

"ATTENTION! Take a look at those leaky faucets about your home . . . then check the charts at left to see how much your water bill can be reduced when they are repaired. Use every Drop You Need—But Stop That Drip! YOUR WATER COMPANY has fully met the extraordinary demands of war production plants using immense quantities of water . . . and of 10,000 new consumers, through its program of conservation . . . in which the small consumers have shown commendable vigilance! Minimum Rate Reductions are your reward . . . and we hope your incentive to continue water conservation."

Stop Those Drips!

Aptly applied to the war situation, is the above slogan used by Kansas City, Mo., Water Department on its water (postcard) bill. We have Mr. M. P. Hatcher, Director of the Dept. of Water, Kansas City, to thank for this timely, clever reminder that by stopping water leaks and unnecessary usage of water, consumers can help to *stop those drips* Hitler and Hirohito!

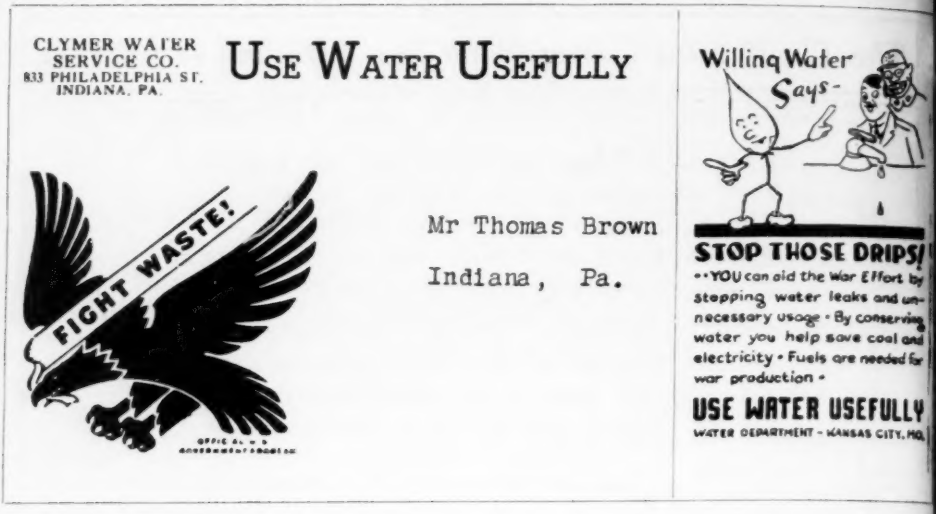
Writes Mr. Hatcher: "I thought the enclosed card might interest you. It was our first attempt to make use of Willing Water."

This use of postcard bills is one of the most effective methods of getting the *use water usefully* message across to the consumers. Printed in the unused space on the address side of the card, it catches the eye instantaneously and delivers the good word!

Mr. William Insull, Division Manager of Northeastern Water & Electric Service Corporation, Latrobe, Pennsylvania, takes time off from his arduous duties to send us copies of the postcard bill being used by Clymer Water Service Company (operated by North-

The Thrill That Comes Once in a Lifetime BY WEBSTER

Courtesy N.Y. Herald ***Tribune***



eastern), on which a water conservation message is carried, along with the "Fight Waste" eagle released by the U.S.Government in its campaign against waste.

You water works men are busy, *we know;* but do take a couple of minutes off and send us your contributions to the water conservation campaign whether it is big or small.

Willing Water in War Time

Below is illustrated a gummed sticker $10\frac{1}{2} \times 3\frac{1}{4}$ in., which is printed in red ink on white paper stock. Why not distribute Willing Water and his wartime message to your customers? Placed in prominent locations, these stickers can be effective in helping to correct leaks and in helping to put over your message to your customers. The sticker can be ordered in lots of 1,000 for $30.00; 2,500 for $40.00; 5,000 for $60.00. Send your order to American Water Works Association, 500 Fifth Ave., (18) N.Y.